Supreme Court, U.S.
FILED
NOV 14 2003
OFFICE OF THE CLERK

No. 02-1593

IN THE

SUPREME COURT OF THE UNITED STATES

BEDROC LIMITED, LLC; WESTERN ELITE, INC.,

Petitioners,

v.

UNITED STATES OF AMERICA; GALE A. NORTON; BUREAU OF LAND MANAGEMENT; CURTIS TUCKER; UNITED STATES DEPARTMENT OF THE INTERIOR,

Respondents.

On Writ of Certiorari to The United States Court of Appeals for the Ninth Circuit

---

JOINT APPENDIX

THEODORE B. OLSON
Solicitor General
Counsel of Record
U.S. Department of Justice
Washington, D.C. 20530
Phone: (202) 514-2217
Fax: (202) 514-8844
Counsel for Respondents

R. TIMOTHY MCCRUM
Counsel of Record
CLIFTON S. ELGARTEN
ELLEN B. STEEN
CROWELL & MORING LLP
1001 Pennsylvania Ave., NW
Washington, DC 20004
Phone: (202) 624-2500
Fax: (202) 628-5116

L. ERIC LUNDGREN
LUNDGREN LAW OFFICES, PC
P.O. Box 746
Cheyenne, WY 82003
Phone: (307) 632-0132
Fax: (307) 632-0159
Counsel for Petitioners

Petition for Certiorari Filed April 30, 2003
Certiorari Granted September 30, 2003

---

124 pp

TABLE OF CONTENTS

Page

Relevant Docket Entries in the District Court 1

Relevant Docket Entries in the Court of Appeals 6

Declaration of Earl Williams (1/30/99) (Exhibit 6 to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 16), filed on 2/1/99; Original Declaration filed on 2/8/99)..... 10

Declaration of Floyd R. Lamb (1/30/99) (Exhibit 3 to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 16), filed on 2/1/99; Original Declaration filed on 2/8/99)..... 11

Photo No. 1 of Property (Exhibit 8 to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 16), filed on 2/1/99) 13

Photo No. 2 of Property (Exhibit 8 to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 16), filed on 2/1/99) 14

Photo No. 3 of Property (Exhibit 8 to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 16), filed on 2/1/99) 15

DOI Designation of Property as Non-mineral (10/5/34) (Exhibit 9 to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 16), filed on 2/1/99)..... 16

Final Certificate to Newton and Mabel Butler (9/22/39) (Exhibit 1 to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 16), filed on 2/1/99). 18

Land Patent to Newton and Mabel Butler (3/12/40)

(Exhibit 4 to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 16), filed on 2/1/99). 20

BLM Notice of Trespass (4/1/93) (Exhibit 7 to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 16), filed on 2/1/99) 22

BLM Notice of Trespass (3/26/93) (attached to Defendants' Brief on Mineral Ownership (Dist. Ct. Docket No. 20), filed on 2/1/99) 26

BLM Decision re Notice of Trespass (4/23/93) (attached to Defendants' Brief on Mineral Ownership (Dist. Ct. Docket No. 20), filed on 2/1/99)..... 29

Declaration of Jerry B. Fant (3/18/99) (attached to Defendants' Brief in Support of Mineral Ownership and in Opposition to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 26), filed on 3/18/99; Original Declaration filed on 3/30/99)..... 34

1914 U.S.G.S. Mineral Resources, Part II – Nonmetals (attached to Defendants' Brief in Support of Mineral Ownership and in Opposition to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 26), filed on 3/18/99) 37

1915 U.S.G.S. Mineral Resources, Part II – Nonmetals (attached to Defendants' Brief in Support of Mineral Ownership and in Opposition to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 26), filed on 3/18/99) 46

1916 U.S.G.S. Mineral Resources, Part II – Nonmetals (attached to Defendants' Brief in Support of Mineral Ownership and in Opposition to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 26), filed on 3/18/99) 59

1917 U.S.G.S. Mineral Resources, Part II – Nonmetals (attached to Defendants' Brief in Support of Mineral Ownership and in Opposition to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 26), filed on 3/18/99) 71

1918 U.S.G.S. Mineral Resources, Part II – Nonmetals (attached to Defendants' Brief in Support of Mineral Ownership and in Opposition to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 26), filed on 3/18/99) 86

1919 U.S.G.S. Mineral Resources, Part II – Nonmetals (attached to Defendants' Brief in Support of Mineral Ownership and in Opposition to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 26), filed on 3/18/99) 103

District Court Judgment for Defendants (5/25/99) 119

Note: The following do not appear in the Joint Appendix but were reproduced in the Appendix to the Petition for Writ of Certiorari:

Appendix C: IBLA Opinion (10/6/97)..... 39a-63a

Appendix B: District Court Order (5/25/1999)..... 22a-38a

Appendix A: Ninth Circuit Opinion (12/30/02)..... 1a-21a

Relevant Docket Entries

U.S. District Court for the District of Nevada

Civil Action No. CV-S-98-01012

DATE	N.R	PROCEEDING
7/13/98	1	COMPLAINT obo P (AT) mj
8/25/98	6	SUMMONS w/retn serv; D Curtis Tucker servd via cert mail on 7/17/98 (AT) sml.
	7	SUMMONS w/retn serv; D U.S.A. servd 7/20/98 via cert mail (AT) sml (to Janet Reno)
	8	SUMMONS w/retn serv; D U.S.A. servd (U.S. Atty/Reno, NV) via cert mail on 8/19/98
	9	SUMMONS w/retn serv; D U.S. Dept/Interior servd 7/22/98 via cert mail (AT) sml
	10	SUMMONS w/retn serv; D Bruce Babbitt servd via cert mail on 7/20/98 (AT) sml
10/19/98	11	ANSWER to cmplt obo Ds. (m) (AT) bh
11/9/98	12	AMENDED ANSWER & COUNTERCLAIM obo all ds (m) (AT) sml
12/1/98	13	ANSWER (entitled, "Reply") to Ds Cntrclaim #12 obo Ps/Contrdefs (p) (AT) sml
12/10/98	15	DISCOVERY PLAN/SCHEDULING ORDER (PMP) ORD Ct. stay all other pretrial proceeding until mineral reservation issue resolved. On/bef 1/30/99, ptys shall

		submt concurrent brfs on mineral reservatn issues. On/bef 3/1/99, ptys shall submt concurrent brfs respnding to 1/30/99 brfs submtd by opposing pty. W/in 30 days after entry/ord by ct (in re mineral reservatn issues), ptys shall submt new pro disc plan/sched ord, etc. (AT) Cps dist. sml
2/1/99	16	MOTION for S/J obo Ps (m) (AT) sml w/#17, #19, #20, #21 (FILED SEPARATELY)
	17	NOTICE of Filing a Fax Declaration (in re #16/Patricia Richards) obo Ps (m) (AT) sml
	18	NOTICE of Filing Unsigned Declaration (in re #16/Earl Williams) obo Ps (m) (AT) sml
	19	NOTICE of Filing Unsigned Declaration (in re #16/Floyd R. Lamb) obo Ps (m) (AT) sml
	20	BRIEF ON MINERAL OWNERSHIP obo D USA (as per Ord #15) (m) (AT) sml FILED SEPARATELY
2/3/99	21	ERRATA to Ps Mtn for S/J (#16) (nss) (AT) sml
2/8/99	22	NOTICE of Filing Orig Declarations (in re Mtn #16 & #17-#19) obo Ps (m) (AT) sml
2/10/99	23	AMENDED CERTIFICATE/MAILING of #20 on 2/1/99 obo D USA. Sml
2/11/99	24	CERTIFICATE/MAILING of #16 on 2/10/99 obo Ps (#16 was unsigned on certif./mailing) sml
3/18/99	26	BRIEF in supprt of mineral ownershiop obo D USA. OPPOSITION to Ps mtn for S/J (#16) obo D USA. (m) (AT) kly

3/18/99	27	RESPONSE to US brief on mineral ownership (#26) obo Ps. (m) (AT) kly
3/30/99	28	NOTICE OF FILING orig declaration of Jerry B. Fant re #26 obo D/USA. (m) bh
5/24/99	29	ORDER (PMP) ORD Ps Mtn for S/J (#16) DENIED. FUR ORD Ds Brf in Suppt of Mineral Ownership & Oppo (#26), reqsting a judicial declaratn finding the U.S. to be the owner of all valuable minerals underlying Bedroc's real property, incldng the sand & gravel deposits, is GRANTED, & that Jdgmt is hereby entered in favr of Def/Cntrclaimants U.S.A., Interior Sec'y Bruce Babbit, U.S. Dept. of Interior, Bureau of Land Managemnt, & Curtis L. Tucker & agnst P/CntrDefs Bedroc Ltd, LLC & Earl Williams. EOD 5/25/99 (AT) Cps dist. sml
5/25/99	30	JUDGMENT (LSW/SML) ORD Ps Mtn for S/J DENIED. Ds Brf in Suppt of Mineral Ownership & Oppo reqsting a judicial declaratn finding U.S. to be owner of all valuable minerals underlying Bedroc's real property, incldng the sand & gravel deposits, GRANTED. JDGMT hereby entered in favr of Def/Cntrclaimants U.S.A., Interior Sec'y Bruce Babbit, U.S. Dept. of Interior, BLM, & Curtis L. Tucker & agnst Ps/Ctnrdefs Bedroc Ltd., LLC & Earl Williams. EOD 5/25/99 (AT) Cps dist. sml
6/4/99	31	NOTICE OF APPEAL of Order #29/Jdgmt #30 obo Ps (m) (AT) sml
8/9/99	34	ORDER (cc) from C/A; ORD ptys jt mtn to dismiss appeal w/out prej granted. Appeal

		dismissed w/out prej to reinstatemt should USDC refuse to grant ptys mtn to w/draw its jdgmt in this matter. Ptys must file notice of reinstatemt w/in 28 days of USDC order denying their reqst for w/drawal. (AT) Cps dist. sml
9/9/99	36	JOINT MOTION to withdraw May 25, 1999 Judgment and to stay pretrial proceedings (m) (AT) pv
10/18/99	37	ORDER (PMP) ORD Jt Mtn to W/Draw Jdgmt & Stay PT Proceedings (#36) GRANTED, & Ct Order #29 VACATED & matter placed on clndr on Thurs., 12/9/99, @4:00 pm (AT) Cps dist. EOD 10/18/99. sml
12/10/99	38	MINUTES OF COURT (PMP) (Crt Recrdr: Erica Davis) of 12/9/99 stat hearing. ORD matter referred to LRL for scheduling of settlmt conf w/in next 60 days. FUR ORD ptys file Jt Stat Rept w/ct by 3/9/2000. (AT) Cps dist. sml
8/14/00	49	ORDER STIPULATION. ORD Ps shall amend cmplnt to the extent that Western Elite is added as an additional P. cpys dist.
8/21/00	50	COMPLAINT AMENDED to add Western Elite & to quiet title and for declaratory/injnctive relief obo P. (nss)
9/5/00	51	ANSWER to 1st amend cmplnt obo USA. (m)
7/25/01	71	MINUTES OF PROCEEDINGS HEARING. Ct Reporter: Erica Davis RE: Stat Hrng. (see doc for spfcs). ORD Cnsl

		shall file stip for dism by 8/15/01. cpys dist.
8/21/01	74	ORDER/STIPULATION. ORD This case is DISM. cpys dist.
10/17/01	77	NOTICE OF APPEAL re #29, 30 & 74 obo Ps. (m) Dkt fees pd #52922.
10/18/01	78	TRANSMITTAL (cpy) Orig. to C/A re Ntc of Appeal; Dkt fees pd; Design of transcrpt forms snt; cpy of dkt sheet. cpys dist.
10/30/01	80	CERTIFICATE OF RECORD C/A (cpy) Orig to C/A re Cert of Rcrd. cpys dist.
10/29/01	82	TRANSMITTAL cpy retrn fr C/A & Assigned appeal #01-17030
9/17/02	84	DESIGNATION OF RECORD OF APPEAL (cpy) Orig to C/A w/2 vols. Clks rcrds & 3 oversized folders, cc of dkt sheet. cpys dist.
1/7/03	86	OTHER OPINION frm C/A (see doc for spfcs) Dist Ct jdgmnt is AFFIRMED.
2/24/03	87	OTHER (cpy) frm C/A ORD Judgment of said District Ct is hereby AFFIRMED.
2/24/03	88	JUDGMENT (cc) frm C/A ORD Judgment of said District Ct is hereby AFFIRMED
3/4/03	90	TRANSMITTAL frm C/A re retrn of Clk's rcrds of 2 vols and 3 oversized docs.

U.S. Ninth Circuit Court of Appeals

No. 01-17080

10/23/01	DOCKETED CAUSE AND ENTERED APPEARANCES OF COUNSEL. CADS SENT (Y/N): n. setting schedule as follows: appellant's designation of RT is due 10/29/01; appellee's designation of RT is due 11/6/01; appellant shall order transcript by 11/16/01; court reporter shall file transcript in DC by 12/17/01; certificate of record shall be filed by 12/24/01; appellant's opening brief is due 2/4/02; appellees' brief is due 3/4/02; appellants' reply brief is due 3/18/02 [01-17080] (gar)
10/23/01	Filed Christian B. Bryner for Appellant Western Elite, Inc., Appellant Bedroc Limited, LLC Civil Appeals Docketing Statement served on 10/17/01 (to CONFATT) [01-17080] (gar)
10/29/01	Received copy of transcript designation and ordering form filed in DC (NT) (sent to case file) (gail)
11/2/01	Filed certificate of record on appeal RT filed in DC 10/30/01 [01-17080] (gail)
11/8/01	Filed notice of appearance of L. Eric Lundgren for Aplts BedRoc Limited and Western Elite, Inc. [01-17080] (gail)
1/28/02	14 day oral extension by phone of time to file Appellant brief. [01-17080] appellants' brief due 2/19/02; appellees' brief due

	3/21/02; appellants' reply brief due 14 days fr svc of ans br. (terr)
2/21/02	Filed original and 15 copies Appellants Bedroc Limited, LLC and Western Elite, Inc.'s opening brief (Informal: no) 45 pages; 5 excerpts of record (01 Exc.vol); served on 2/19/02 (minor defcy: missing st of rel cases) Notified counsel. [01-17080] (gail)
3/8/02	Received Appellant Bedroc Limited, LLC satisfaction of (minor) brief deficiency (st of rel cases) [01-17080] (gail)
3/22/02	Filed original and 15 copies appellee USA's 41 pages brief, 01 Supp'l Exc. Vols; served on 3/21/02 [01-17080] (gail)
4/12/02	Filed original and 15 copies Bedroc Limited, LLC, Western Elite, Inc. reply brief (Informal: no) 22 pages; served on 4/8/02 [01-17080] (gail)
9/6/02	CALENDARED: San Francisco November 7, 2002 9:00 a.m. Courtroom 4 [01-17080] (mw)
11/7/02	ARGUED AND SUBMITTED TO Michael D. HAWKINS, Susan P. GRABER, Richard C. TALLMAN [01-17080] (pi)
12/30/02	FILED OPINION: AFFIRMED (Terminated on the Merits after Oral Hearing; Affirmed; Written, Signed, Published. Michael D. HAWKINS; Susan P. GRABER, author; Richard C. TALLMAN.) FILED AND ENTERED JUDGMENT [01-17080] (hh)

2/20/03	MANDATE ISSUED [01-17080] (sm)
3/27/03	Rec'd ltr from USSC dated 3/21/03 re: application for extension of time to file petition to and including 4/30/03 for writ of certiorari [01-17080] (ld)
5/9/03	Received notice from Supreme Court: petition for certiorari filed Supreme Court No. 02-1593 filed on 4/30/03 [01-17080] (sm)
10/6/03	Received notice from Supreme Court, petition for certiorari GRANTED on 9/30/03. Supreme Court No. 02-1593 (PANEL) (sm)

Note: The first eighteen documents that follow in this Joint Appendix were submitted as exhibits in:

UNITED STATES DISTRICT COURT

District of Nevada

BEDROC LIMITED, L.L.C., et al.,

Plaintiffs/
Counterdefendants,

v.

THE UNITED STATES OF AMERICA, et al., CV-S-98-01012-PMP (LRL)

Defendants/
Counterclaimants.

[Exhibit 6 to Plaintiffs' Motion for Summary Judgment
(Dist. Ct. Docket No. 16)]

DECLARATION OF EARL WILLIAMS

I, Earl Williams, do hereby swear on oath as follows:

1. My name is Earl Williams.

2. I am over the age of 18 years and make this Declaration based on my personal knowledge.

3. I have personal knowledge of the parcel property owned by Bedroc, as I was once an owner of said property.

4. I certify that the pictures of the Bedroc parcel are a fair and accurate representation of the property, sand, gravel and surface character of the property.

5. I also certify that the market for gravel and sand did not become economically viable with respect to the Bedroc parcel until the 1990s.

6. The reason there was not a market for sand and gravel for the Bedroc parcel is it is approximately 63 miles from Las Vegas, which is the primary market for the sand and gravel, and only recently did the expansion of Las Vegas create a viable market for sand and gravel.

7. I certify prior to operating our sand and gravel operation, Mr. Whisenant, a lessee, operated a sand and gravel operation for several years without interference by the BLM.

I declare, certify, verify and state under penalty of perjury that the foregoing is true and correct.

EXECUTED this 30th day of January 1999.

/s/ Earl Williams
Earl Williams

[Exhibit 3 to Plaintiffs' Motion for Summary Judgment
(Dist. Ct. Docket No. 16)]

DECLARATION OF FLOYD R. LAMB

I, Floyd [originally "Lloyd"; hand correction initialed by "FRL"] R. Lamb, do hereby swear on oath as follows:

1. My name is Floyd R. Lamb.
2. I am over the age of 18 years and make this Declaration based on my personal knowledge.
3. I have personal knowledge about the parcel of property now owned by Bedroc, L.L.C.
4. I knew the individuals who patented the subject property, Mr. and Mrs. Butler on or around 1940.
5. I knew the Butlers on a personal level, and even worked with Mr. Butler on the property.
6. Specifically, I helped Mr. Butler make cement blocks for use on the property. We built these concrete blocks in the early 1940s, possibly 1942.
7. We obtained the sand and gravel necessary to make the concrete blocks from the surface of the Butlers' property.
8. I remember that the Butlers obtained the sand and gravel from a little sand wash on the property.
9. There was absolutely no market for gravel and sand in the 1940s.
10. Sand and gravel was visibly in abundance on the Butlers' property.
11. Mr. Butler built an underground concrete pipeline using the sand and gravel from the property. The concrete pipeline was approximately one-fourth of a mile long and

was constructed to help transport water out of the ground down to hayfields.

12. In addition, Mr. Butler used the sand and gravel on the property to built a concrete floor under an awning off of the West side his house.

13. The awning and concrete floor led down to a stream Mr. Butler constructed which ran through his yard. The floor of the stream was out of concrete using sand and gravel from his property.

I declare, certify, verify and state under penalty of perjury that the foregoing is true and correct.

EXECUTED this 30 day of January, 1999.

/s/ Floyd R. Lamb

Floyd R. Lamb

[Exhibit 8 to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 16)]

[Exhibit 8 to Plaintiffs' Motion for Summary Judgment
(Dist. Ct. Docket No. 16)]

[Exhibit 8 to Plaintiffs' Motion for Summary Judgment
(Dist. Ct. Docket No. 16)]

[Exhibit 9 to Plaintiffs' Motion for Summary Judgment
(Dist. Ct. Docket No. 16)]

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON

The Honorable

The Secretary of the Interior.

Sir:

The following areas, under the provisions of the Nevada ground-water reclamation act of October 23, 1919 (41 Stat. 293), as construed by the Department, are nonmineral, nontimbered, and are not known to be susceptible of successful irrigation at a reasonable cost from any known source of water supply, and I therefore recommend their designation under the said act;

GROUND WATER RECLAMATION DESIGNATION NO. II

NEVADA

Mount Diablo Meridian

Carson City land district

****

The above described lands will be subject to disposal under the terms of the Nevada ground-water reclamation act in so far as they are unappropriated, public, and unaffected by any special provision of law, withdrawal or reservation

inconsistent with the provisions of said act.

The area included in this designation is approximately *,600 acres. The action recommended affects applications for permits listed below by serial numbers. All lands included in these applications, on approval of this order, will have been designated under the provisions of said act of October 22, 1919.

Carson City land district

***

***

Respectfully,
/s/
Director.

Approved Oct. 5, 1934
And referred to the General Land Office
To become effective immediately
/s/ T.A. Walters
First Assistant Secretary of the Interior

4 carbon copies to General Land Office

[Exhibit 1 to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 16)]

Department of the Interior

United States Land Office Carson City, Nevada
Authorized by "F" Aug. 22, 1939

Final Certificate
(Act of October 22, 1919, 41 Stat., 293)

Receipt No. 3134649 *Serial No.* 018212

August 29, 1939

It is hereby certified, that, in pursuance of the act of Congress approved October 22, 1919 (41 Stat., 293), entitled "An Act to encourage the reclamation of certain arid lands in the State of Nevada, and for other purposes,"

Newton N. and Mabel C. Butler,

of Alamo, County of Lincoln, State of Nevada has made proof for the land described as follows, to wit:

E½, E½W½ Sec. 24, E½NE¼ Sec. 25, T.11 S., R. 62 E., M.D.M.

***

containing 560 acres.

Now, therefore, be it known, that, on presentation of this Certificate to the COMMISSIONER OF THE GENERAL LAND OFFICE, the said Newton N. and Mabel C. Butler shall be entitled, if all then be found regular, to receive a Patent for the land above described, subject to and containing a reservation to the United States of all the coal and other valuable minerals in the land, together with a right

to prospect for, mine, and remove same.

/s/ Gladys E. Huyck

Register.

/s NOTE.-A duplicate of this Certificate is issued to the permittee. The original is forwarded to the General Land Office, with the final proof papers, for approval by the Commissioner of the General Land Office and issuance of patent. The duplicate copy forwarded to the permittee should be held until notice of issuance of patent is received.

In all correspondence concerning the case in connection with which this Certificate issued, refer to the NAME OF THE LAND OFFICE AND THE SERIAL NUMBER noted hereon.

Posted Sept. 12, 1939 in Vol. 136, p. **, by /s/_____, Div. "O."

APPROVED Sept. 22-1939

By /s/_____, Division T

[Exhibit 4 to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 16)]

Carson City 018212

4-1040

THE UNITED STATES OF AMERICA
To all to whom these presents shall come, Greeting:

WHEREAS, A Certificate of the Register of the Land Office at Carson City, Nevada, has been deposited in the General Land Office,

whereby, it appears that, in accordance with the provisions of Section five of the Act of Congress of October 22, 1919 (41 Stat. 293-295), entitled, "An Act To encourage the reclamation of certain arid lands in the State of Nevada and for other purposes," Newton N. Butler and Mabel C. Butler are entitled to a patent for the east half and the east half of the west half of Section twenty-four and the east half of the northeast quarter of Section twenty-five in Township eleven south of Range sixty-two east of the Mount Diablo Meridian, Nevada, containing five hundred sixty acres, according to the Official Plat of the Survey of the said Land, on file in the General Land Office:

NOW KNOW YE, That the UNITED STATES OF AMERICA, in consideration of the premises, and in conformity with the said Act of Congress, HAS GIVEN AND GRANTED, and by these presents DOES GIVE AND GRANT unto the said Newton N. Butler and Mabel C. Butler and to their heirs, the Tract of Land above described; TO HAVE AND TO HOLD the same, together with all the rights, privileges, immunities, and appurtenances, of

whatsoever nature, thereunto belonging, unto the said Newton N. Butler and Mabel C. Butler and to their heirs and assigns forever; subject to any vested and accrued water rights for mining, agricultural, manufacturing, or other purposes, and rights to ditches and reservoirs used in connection with such water rights, as may be recognized and acknowledged by the local customs, laws, and decisions of courts; and there is reserved from the lands hereby granted a right of way thereon for ditches or canals constructed by the authority of the United States; reserving, also, to the United States all the coal and other valuable minerals in the lands so granted, together with the right to prospect for, mine, and remove the same upon compliance with the conditions of and subject to the limitations of Section eight of said Act.

IN TESTIMONY WHEREOF, I, Franklin D. Roosevelt, President of the United States of America, have caused these letters to be made Patent, and the Seal of the General Land Office to be hereunto affixed. GIVEN under my hand, at the City of Washington, the TWELFTH day of MARCH in the year of our Lord one thousand nine hundred and FORTY and of the Independence of the United States the one hundred and SIXTY-FOURTH

By the President /s/ Franklin D. Roosevelt

By /s/

/s/

Recorder of the General Land Office

RECORDED: Patent Number 1107339

[Exhibit 7 to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 16)]

9230
N57158
(NV-055.05)

APR 01 1993

(702) 726-8100

HAND DELIVERED

Earl Williams
750 Fogg
Las Vegas, NV 89110

TRESPASS NOTICE

You are hereby notified that the Bureau of Land Management has made an investigation, and evidence tends to show that you are in trespass. We allege that you are violating and/or have violated the laws specified below and that the regulations approved by the Secretary of the Interior pursuant to the authority vested in him by said laws. Therefore, it is our opinion that you:

Have committed the following acts:

1. Removal of mineral materials (sand and/or gravel) from private land where the minerals are reserved to the Federal Government under the Act of Congress of October 22, 1919 (41 Stat. 293-295), and set forth in Patent 1107339 issued on March 12, 1940. Location

of the alleged trespass is T.11S. R.62E., Section 24 E1/2, E1/2 W1/2 and T.11S., R.62E., Section 25 E1/2 NE1/4, Lincoln County, Nevada.

2. Sale of reserved mineral material (sand and/or gravel) without a valid contract or authorization of the Federal Government.

Are in violation of the following laws:

1. Revised Statute 2478; 43 U.S.C. 1201
2. Sections 302 and 310 of the Federal Land Policy and Management Act of 1976 as amended; 43 U.S.C. 1732, 1740.

And are in violation of the following regulations:

1. 43 CFR 3809.0-7 which states "The extraction, severance, injury, or removal of timber or mineral materials from public lands under the jurisdiction of the Department of the Interior, except when authorized by law and regulations of the Interior, except when authorized by law and regulations of the Department, is an act of trespass. Trespassers will be liable in damages to the United States, and will be subject to prosecution for such unlawful acts."

Operations, if continuing, must stop immediately.

If you have evidence or information which tends to show you are not in trespass as we have alleged, you are allowed 15 working days from receipt of this notice to present such evidence or information at the Caliente Resource Area Office of the Bureau of Land Management.

The measure of damages for mineral trespass is subject to state law. Nevada State law, however, does not prescribe the measure of trespass damages for minerals or mineral materials, such as sand, gravel, and stone. For mineral trespass in a state where state law does not govern mineral

trespass, the provisions of 43 CFR 9230.1-3 sets the measure of damages to be applied in a mineral trespass. The measure of damages for innocent trespass is the value of the material in place. The measure of damages for a willful trespass is the full value of the material at the time of sale (conversion) without a deduction for labor bestowed or expense incurred in removing and marketing the material. The cost of transporting the material from the pit to the point of sale is not considered in the trespass.

If the allegations we have made are correct, you must permanently cease and desist from the violations charged, if you have not already done so. You are allowed 15 working days from receipt of this notice to supply the Caliente Resource Area with all information required in order to effect a settlement for trespass damages. In order to effect this settlement, you must provide copies of all sales records and haul records (certified copies of mining records showing the names, addresses, and telephone numbers of buyers, quantities of materials sold, and dates of delivery) from the subject parcel of land. The amount of differentiated material (i.e., Type II, Reject Sand, Pit Run) should be identified.

Failure to comply with this notice will result in further action to protect the interests of the United States. You are further advised that the authorized officer may refuse to sell timber or mineral materials, or issue a permit, lease, or license to a trespasser who has failed to make satisfactory arrangements to satisfy his/her liability to the United States, as provided in 43 CFR 9239.

/s/ CURTIS G. TUCKER

Curtis G. Tucker
Area Manager
Caliente Resource Area

Enclosure:
1. Patent Certificate 1107339

cc: Ed Seum
NV053
Las Vegas District

Franklin F. Snyder
1516 Laburnum Street
Chesterbrook Woods
McLean, VA 22101

[Attached to Defendants' Brief on Mineral Ownership (Dist. Ct. Docket No. 20)]

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
CALIENTE RESOURCE AREA
TRESPASS NOTICE

Number: N57158
State: Nevada
District: Las Vegas
Date: March 26, 1993

Earl Williams
750 Fogg
Las Vegas, NV 89110

YOU ARE HEREBY NOTIFIED That the Bureau of Land Management has made an investigation and evidence tends to show that you are in trespass. We allege that you /_/ are violating /x/ may have violated /_/ have violated the law(s) specified below and the regulation(s) approved by the Secretary of the Interior pursuant to the authority vested in him by said law. Therefore, it is our opinion that you:

Have committed the following act(s):

The removal and sale of mineral materials (sand and gravel) that are reserved to the Federal Government under the Act of Congress of October 22, 1919 (41 Stat. 293-295), and set forth in Patent 1107339 issued on March 12, 1940 without permit or authorization of the Bureau of Land Management.

Are in violation of the following law(s):

R.S. 2478; 43 USC 1201

And are in violation of the following regulation(s):

43 Code of Federal Regulations 9239.0-7:

"The extraction, severance, injury, or removal of timber or mineral materials from public lands under the jurisdiction of the Department of Interior, except when authorized by law and the regulations of the Department, is an act of trespass. Trespassers will be liable in damages to the United States, and will be liable for prosecution for such unlawful acts.

On the following-described land *(describe the area by legal subdivision if surveyed, or if unsurveyed, by concise reference to such natural landmarks as will clearly identify the area):*

T.11S., R.62E., section 24E1/2, E1/2W1/2
T.11S., R.62E., section 25 E1/2NE1/4
Mount Diablo Meridian, Lincoln County, Nevada

1. /X/ Violations, if continuing, *must* stop immediately 2. /_/ You are allowed days from receipt of this notice to cease the alleged trespass operation. 3. /X/ If you have evidence or information which tends to show you are not a trespasser as we have alleged, you are allowed 15 days from receipt of this notice to present such evidence or information at the Bureau of Land Management office shown on the front of this form You are allowed 15 days from receipt of this notice to appear at the Bureau of Land Management office.	shown on the front of this form to effect a settlement for trespass damages Failure to comply with this notice will result in further action to protect the interests of the United States. You are further advised that the authorized officer may refuse to issue a permit, lease, or license to a trespasser who has failed to make satisfactory arrangements to satisfy his liability to the United States, as provided in 43 CFR 4150.3e and 4170.1-1. The officer may also refuse to setll timber or materials as provided in 43 CFR 9239.0-9.

/s/ Curtis G. Tucker (Signature)

Area Manager (Title)

[Certificate of Service omitted in printing]

[Attached to Defendants' Brief on Mineral Ownership (Dist. Ct. Docket No. 20)]

N57158
9230
(NV-055.05)

CERTIFIED MAIL P 504 307 806
RETURN RECEIPT REQUESTED

APR 23 1993

DECISION

Earl Williams
750 Fogg
Las Vegas, NV 89110

NOTICE OF TRESPASS

On April 16, 1993 the Caliente Resource Area office received your response to Trespass Notice (N57158). Careful consideration has been given to the information you have submitted and it is our opinion that you are in mineral material trespass for removing mineral materials reserved to the Federal Government under the Act of Congress of October 22, 1919 (41 Stat. 293-295), also known as the Pittman Act, without authorization of the U.S. Government. Section 8 of the Pittman Act states:

> "That all entries made and patents issued under the provisions of this Act shall be subject to and contain a reservation to the United States of all the coal and

> other valuable minerals in the lands so entered and patented, together with the right to prospect for, mine, and remove the same."

In the case of Watt v. Western Nuclear, Inc., 103 S. Ct. 2218, the United States Supreme Court ruled that "gravel is a mineral reserved to the United States in lands patented under the Stock-Raising Homestead Act." Further the Supreme Court ruled that:

> "Given Congress' understanding that the surface of SRHA lands would be used for ranching and farming, we interpret the mineral reservation in the Act to include substances that are mineral in character (i.e., that are inorganic), that can be removed from the soil, that can be used for commercial purposes, and that there is no reason to suppose were intended to be included in the surface estate. . .Insofar as the purposes of the SRHA are concerned, it is irrelevant that gravel is not metalliferous and does not have a definite chemical composition. What is significant is that gravel can be taken from the soil and used for commercial purposes."

As a result of the extraction and removal of mineral materials reserved to the U.S. Government without proper authorization, it is our opinion that you have violated Revised Statute 2478; 43 U.S.C. 1201 and Sections 302 and 310 of the Federal Land Policy Management Act of 1976 as amended; 43 U.S.C. 1732, 1740; and that you are in violation of 43 CFR 9239.0-7 which states:

> "The extraction, severance, injury, or removal of timber or mineral materials from public land under the jurisdiction of the Department of the Interior, except when authorized by law and the regulations of the Department, is an act of trespass.

Trespassers will be liable in damages to the United States, and will be subject to prosecution of such unlawful acts."

The above stated violation occurred in T.11S., R.62E, Section 24 E1/2, E1/2 W1/2 and T.11S., R.62E., Section 25 E1/2 NE1/4; Mount Diablo Meridian, Lincoln County, Nevada. By your continued removal and sale of sand and gravel without the benefit of a mineral materials contract issued by the Bureau of Land Management, it is our opinion that you committed an act of innocent trespass.

Operations, if continuing, must stop immediately. No further removal of mineral material can take place without a contract from the Bureau of Land Management. Continued removal of mineral materials without a BLM contract from the parcel of land described above after receiving this Decision will be considered an act of willful trespass and will result in issuance of citations for theft of government property.

Nevada State law does not prescribe the measure of trespass damages for minerals or mineral materials, such as sand, gravel, and stone. For a minerals trespass in a state where State law does not govern mineral trespass, the provisions of 43 CFR 9230.1-3 (see Code of Federal Regulations, 1992) sets the measure of damages to be applied in a mineral trespass. The measure of damages for innocent trespass are the value of the minerals in place. The measure of damages for a willful trespass is the full value of the material at the time of sale (conversion) without a deduction for labor bestowed or expenses incurred in removing and marketing the material. The cost of transporting the material from the pit to the point of sale is not considered in the trespass.

To resolve this trespass, you must supply the Caliente Resource Area Office all records from beginning of production on the above described parcel to the date of receipt of this Decision. In order to effect settlement, you

must provide copies of all sales records and haul records (certified copies of mining records showing the names, addresses, and telephone numbers of buyers, quantities of materials sold, and dates of delivery) from the subject parcel of land. The amount of differentiated material (i.e., Type II, Reject Sand, Pit Run) should be identified.

The BLM is currently engaged in the process of calculating the volume of mineral material removed from the site by this trespass. This amount will be compared with the figures provided by you as to the amount of material removed and sold from the site.

You have 30 dyas from the date of receiving this letter to supply the above described information. Failure to comply with this decision may result in the BLM further pursuing civil and criminal action to be taken for theft of government property.

Within 30 days of receipt of this decision, you have the right of appeal to the Board of Land Appeals, Office of the Secretary, in accordance with the regulations in 43 CFR 4.400. If an appeal is taken, you must follow the procedures outlined in the enclosed Form 1840-2, Information on Taking Appeals to the Board of Land Appeals. Within 30 days after you appeal, you are required to provide a Statement of Reasons to the Board of Land Appeals and a copy to the Regional Solicitor's Office listed in Item 3 on the form. In addition, please provide this office with a copy of your Statement of Reasons. The appellant has the burden of showing that the decision appealed from is in error.

In addition, within 30 days of receipt of this Decision, you have the right to file a petition for a stay (suspension) of the Decision together with your appeal in accordance with the regulations at 43 CFR 4.21. The petition must be served upon the same parties specified above. The appellant has the burden of proof to demonstrate that a stay should be granted.

/s/ Curtis G. Tucker
Curtis G. Tucker
Area Manager

Enclosure

cc: Ed Seum
NV053

TRESPASS.LE1
SFLOCK/wm 04/23/93

[Attached to Defendants' Brief in Support of Mineral Ownership and in Opposition to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 26)]

UNITED STATES DISTRICT COURT
DISTRICT OF NEVADA

BEDROC LIMITED, L.L.C., et al.	)	
	)	
Plaintiffs/Counterdefendants,	)	
	)	
v.	)	CV-S-98-01012-PMP (LRL)
	)	
THE UNITED STATES OF AMERICA et al.,	)	
	)	
Defendants/ Counterclaimant.	)	
	)	

DECLARATION OF JERRY B. FANT

Pursuant to 28 U.S.C. § 1746, I, JERRY B. FANT, declare as follows:

1. I am a geologist with the Ely Field Office of the United States Department of the Interior, Bureau of Land Management. I have been employed in this position since February 22, 1993.

2. I received a Bachelor of Science Degree from Northeast Louisiana University in 1980.

3. In connection with my studies to become a geologist

and in my duties as a geologist, I have learned the appropriate methodology to measure irregularly shaped structures and to calculate the volume of those structures.

4. I am familiar with the same and gravel operations conducted by Bedroc Limited, L.L.C. ("Bedroc"), and have visited those operations on several occasions. I am familiar with the acreage disturbed by Bedroc's sand and gravel operations. Bedroc has provided the Bureau of Land Management with maps showing the area disturbed, and I have visited the site on several occasions.

5. In my visits to the Bedroc sand and gravel operations, I have seen piles of material that I would characterize as topsoil located on the west side of Bedroc's excavation and one topsoil stockpile to the south of Bedroc's excavations as well as other smaller stockpiles that were not mapped or considered in making the calculations in this declaration due to time constraints.

6. In early March, 1999, I traveled to the Bedroc location and examined the topsoil stockpiles. These piles appear to be overburden that were pushed from off of the top of the area where Bedroc is conducting its mining operation. I measured the length, width and height of most but not all of the piles of topsoil. The topsoil stockpile along the west side of the excavation has a very irregular shape and was difficult to map. Also, Bedroc's operations have captured the east-central and southeastern portion of the western topsoil stockpile.

7. After taking the measurements, I calculated the volume of the material. These calculations took into account the possible material removed and the length, width and height measurements were averaged together. Based on my measurements and calculations, I estimate that the total volume of topsoil in the stockpiles to be 54,300 cubic yards.

8. Based on my review of the maps provided by Bedroc to the Bureau of Land Management and my recollection of the site, it appears that Bedroc has disturbed and removed sand and gravel from approximately 16.2 acres. There are 43,560 square feet in each acre. A cubic yard contains 27 cubic feet of material. To cover one acre one foot deep in topsoil you would have to have 43,560 cubic feet of topsoil. Using the 54,300 cubic yard topsoil figure, one would have enough to cover the entire 16.2 acre area with a two foot thick cover of topsoil. From these calculations, it appears that Bedroc removed on average approximately two feet of top soil from the 16.2 acres in order to reach the sand and gravel deposits. I do not know the original surface topography of the disturbed area but the depth of topsoil on the original surface probably varied from place to place and was not uniformly two feet deep.

I declare under penalty of perjury that the foregoing is true and correct. Executed this 18 day of March, 1999, at Caliente, Nevada.

/s/ Jerry B. Fant

Jerry B. Fant

[Attached to Defendants' Brief in Support of Mineral Ownership and in Opposition to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 26)]

LANDS AND MINERALS
DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

MINERAL RESOURCES

OF THE

UNITED STATES

1914

H.D. MCCASKEY
Geologist in Charge, Division of
Mineral Resources

PART II – NONMETALS

E.F. BUECHARD, Geologist in Charge

[SEAL]

WASHINGTON
GOVERNMENT PRINTING OFFICE
1916

SAND AND GRAVEL

By G.F. LOUGHLIN.

PRODUCTION.

HISTORICAL REVIEW.

In 1902 the value of sand crushed from sandstone and used in the manufacture of glass was for the first time separated from the figures given for stone by the United States Geological Survey and was published in a separate report, which included also the value of other sand used for glass. The process of collecting the figures for 1902 and 1903 revealed a considerable quantity of sand used for molding, building, and various other purposes, and in 1904 it was possible to show approximately the total quantity and value of such sand produced for that year. In 1905 more complete statistics of the total production of sand were obtained, and it was also possible to tabulate the approximate production of gravel. The following table shows the total production of sand and gravel, including glass sand, from 1904 to 1914:

Quantity and value of sand and gravel produced in the United States, 1904-1914, in short tons.

Year.	Quantity.	Value.
1904.....	10,679,723	• $ 5,748,099
1905.....	23,204,967	11,223,645
1906.....	32,932,002	12,698,208
1907.....	41,851,918	14,492,069
1908.....	37,216,044	13,270,032
1909.....	59,565,551	18,336,990

1910.....	69,410,436	21,037,630
1911.....	65,846,959	21,158,583
1912.....	68,354,561	23,113,206
1913.....	79,555,849	24,217,508
1914.....	79,281,735	23,846,999

• Includes a very small quantity of gravel.

More complete returns account principally for the large apparent increase during recent years as compared with 1904. The large increase in quantity and the small increase in value in 1906 and 1907 were mainly in the production of cheap gravel for filling, road ballast, and other uses. In 1908 there was, as in most other industries, a decrease in both quantity and value of production, owing to unsettled financial conditions, but in 1909 there was a large increase, due to the great activity in the building trades, in railroad building, and in the iron industry. In glass sand, however, there was only a slight increase. The production of glass sand and molding and building sand continued to increase in 1910. In 1911 there was a small decrease in total production, although the production of glass sand continued to increase. In 1912 and 1913 the total production increased, though special conditions caused a decrease in the production of certain kinds of sand.

With the exception of 1908 and 1911 there has been a steady increase in total production in both quantity and value to 1913, inclusive. The production in 1914, however, shows a decrease in quantity and in value.

PRODUCTION IN 1914.

In view of slackened building demand in 1914 the decrease in output of sand and gravel was relatively small.

The total production of sand and gravel in the United States in 1914 reported directly to the United States Geological Survey was 79,281,735 short tons, valued at $23,846,999, a decrease in quantity of 277,144 short tons and in value of $370,509 from the production of 1913. It exceeded, however, by 10,927,174 tons in quantity and $733,791 in value the production of 1912, and by 9,871,299 tons in quantity and $2,809,369 in value the production of 1910, when the largest output previous to that of 1913 was recorded.

Notwithstanding the decrease in total production, there was increase in the value of grinding and polishing sand, of paving sand, of sand for railroad ballast, and especially of gravel. The most conspicuous decrease in value was in molding sand in fire and engine sand.

Trade conditions in most of the States which show large production were not so favorable in 1914 as in 1913. In the important Eastern States most producers reported conditions to be poor, although a small number had in creased production, owing to local demand. The same condition prevailed in the Central States, with the exception of Michigan and Iowa, where the producers who reported conditions as about the same as in 1913 were more numerous than those who reported decreased production. In California more than 50 per cent of the producers reported better conditions in 1914 than in 1913.

The following table gives the total production of glass sand in the United States from 1902 and 1914, inclusive:

Quantity and value of glass sand produced in the United States, 1902-1914, in short tons.

Year.	Quantity.	Value.	Average price per ton.
1902.....	943,135	$807,797	$0.86
1903.....	823,044	855,828	1.04
1904.....	858,719	796,492	.92
1905.....	1,060,334	1,107,730	1.04
1906.....	1,089,430	1,208,783	1.11
1907.....	1,187,296	1,250,067	1.05
1908.....	1,093,553	1,134,599	1.04
1909.....	1,104,451	1,163,375	1.05
1910.....	1,461,098	1,516,711	1.04
1911.....	1,538,666	1,543,733	1.01
1912.....	1,465,386	1,430,471	.97
1913.....	1,791,800	1,895,991	1.06
1914.....	1,619,649	1,568,030	.97

The production of glass sand in 1914 amounted to 1,619,649 short tons, valued at $1,568,030, a decrease of 172,151 tons, or 9.6 per cent, in quantity and of $327,961, or 17.3 per cent, in value from the production of 1913. The average price per ton fell from $1.06 in 1913 to $0.97.

The following table gives the production of molding sand in the United States since 1904, when the first statistics of molding sand were collected:

Quantity and value of molding sand produced in the United States, 1904-1914, in short tons.

Year.	Quantity.	Value.	Average price per ton.
1904.....	3,439,214	$2,125,370	$0.62
1905.....	3,084,098	2,102,423	0.68

1906.....	3,371,103	2,063,151	0.61
1907.....	3,682,494	2,460,754	0.67
1908.....	1,980,677	1,342,802	0.67
1909.....	3,122,806	2,146,220	0.68
1910.....	3,636,167	2,431,254	0.67
1911.....	3,376,717	2,132,469	0.63
1912.....	4,485,380	2,718,726	0.61
1913.....	3,563,583	2,230,217	0.63
1914.....	2,751,209	1,756,383	0.64

The decrease in the production of molding sand in 1914 was 812,374 short tons and $473,834, or 22.7 per cent in quantity and 21.2 per cent in value. The average price increased from 63 cents to 64 cents a ton. The production of molding sand in 1914 was less than in any year since statistics have been collected by the Survey, with the exception of 1908. The decrease in that year was even more than in 1914, but the recovery was rapid and the production two years later, in 1910, was the greatest in quantity that has been recorded. The production of molding sand reflects to a considerable extent the condition of the iron and steel industry.

The following tables give the production of the various kinds of sand and the production of gravel by States in 1913 and 1914:

[Tables omitted]

* * *

Sand for building purposes constituted, as in previous years, more than one-half of the total sand production. The production in 1914 was 24,003,962 short tons, valued at $7,688,774. This was a decrease of 1,393,421 tons, or 5.4 per cent, in quantity and of $319,275, or 3.9 per cent, in value from the production of 1913. The average price per

ton, which increased from 31 cents in 1911 to 33½ cents in 1912 and decreased to 31½ cents in 1913, increased to 32 cents in 1914. Decrease in output and value was not general, as some producers reported an increase both in quantity and in price per ton.

The production of grinding and polishing sand, which decreased in 1913, showed a marked increase in 1914 and was again above 1,000,000 tons. Although the output was 100,000 tons less than in 1912 (the year of highest production), it was more than 200,000 tons greater than in 1911. The production in 1914 was 1,084,871 tons, valued at $652,388, an increase in quantity of 143,498 tons and in value of $111,989 over the production for 1913.

The production of fire sand and furnace sand, like that of molding sand, decreased greatly. The quantity produced in 1914 was 318,560 tons and the value was $187,467, against 519,061 tons, valued at $364,363, in 1913, a decrease of 200,501 tons in quantity and of $176,896 in value.

The production of engine sand increased in quantity from 1,033,450 tons in 1913 to 1,262,790 tons in 1914, but the value decreased from $401,806 to $367,548.

Paving-sand production increased slightly in both quantity and value, from 3,335,508 tons, valued at $1,020,389, in 1913 to 3,580,171 tons, valued at $1,121,999, in 1914.

The production of sand for railroad ballast actually reported to the Survey was 2,116,429 tons, valued at $322,740, in 1914, as against 2,335,196 tons, valued at $266,852, in 1913. The increase in value, notwithstanding a comparatively small decrease in quantity, is notable.

The reported production does not represent the total quantity of sand used for ballast by the railroads, for the reason that some railroads keep no record of the quantity of sand produced and used by them in making cuts and in ballasting their roadbeds. With them it is only a matter of moving material from one point on the right of way to another point.

The production of gravel in 1914 exceeded that of building sand by more than 15,000,000 tons, an excess which was 2,000,000 tons more than that in 1913. The total production of gravel in 1914 was 39,212,858 tons, valued at $9,398,897, an increase in quantity of 686,360 tons and in value of $556,086 over the production of 1913. Those figures show an average cost per ton of nearly 25 cents, as compared with slightly less than 23 cents in 1913 and about 26 cents in 1912. This large quantity of gravel was used for many purposes, including concrete, paving, filter beds, roofing, road making, and railroad ballast. The total production of all kinds of sand in 1914 was 40,068,877 short tons, valued at $14,448,102, an excess of 856,019 tons in quantity and of $5,049,205 in value over the production and value of gravel during that year.

The entire report of the production of sand and gravel is necessarily incomplete, because it is impracticable to attempt to get reports or to estimate the quantity of sand produced by the thousands of individuals who each year dig a small quantity for their own use. This production of which there is no count or accounting, may average less than a ton for the individual producer, but the aggregate may be hundreds of thousands of tons. The figures each succeeding year should be nearer the actual production, as the list of producers is added to annually.

The gravel figures for 1914 do not include a considerable quantity of chats or tailings from the Missouri zinc mines. The production of chats in Missouri in 1914 was 2,270,771 tons, valued at $340,616.

The unit of measurement given in the tables of production is the short ton. Much of the sand is reported as sold by the cubic yard, a cubic yard varying in weight from 2,300 to 3,000 pounds, according to the condition of the sand, to the material of which the gravel is composed, and to the custom of the locality. All of the glass sand is sold by the short ton, and also a considerable quantity of the molding, building, and other sand; hence the quantities reported were all reduced to this unit.

IMPORTS.

Sand valued at $139,675 was imported into the United States in 1914, as compared with imports valued at $172,257 in 1913, $141,690 in 1912, and $147,268 in 1911. This is largely building sand brought to the United States as ballast, or from Canada as a near source of supply; but it includes a small quantity of French molding sand which comes to this country barreled in lump and is here ground and pulverized before marketing.

[Attached to Defendants' Brief in Support of Mineral Ownership and in Opposition to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 26)]

DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

MINERAL RESOURCES

OF THE

UNITED STATES

1915

H.D. MCCASKEY
Geologist in Charge, Division of Mineral Resources

PART II – NONMETALS

E.F. BUECHARD, Geologist in Charge

[SEAL]

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

SAND AND GRAVEL

By R.W. STONE.

TRADE CONDITIONS.

Depression in business during the early part of 1915 and heavy rainfall in some parts of the country account in part for the slight falling off in total production of sand and gravel in 1915. A tabulation of reports on conditions in the sand industry in the principal producing States follows:

Firms reporting condition of sand and grave industry in principal producing States in 191 in comparison with 1914.

State.	Better.	Same.	Worse.
Illinois	29	17	22
Indiana	37	13	25
Michigan	68	49	60
New York	29	23	22
Ohio	58	28	47
Pennsylvania	62	33	43
	281	163	219

This table shows a tendency toward larger business, and the showing is confirmed by the increased quantities of glass, molding, fire, engine, and railroad ballast sand used in 1915 as compared with 1914, as indicated in the tables of production in this report.

The glass business has been very active and continues to be active at this time (June, 1916), partly because of

decreased imports and increased exports of glass, which has naturally resulted in a considerable increase in the quantity of glass sand produced. The output of glass sand in 1915 is the largest ever reported by the United States Geological Survey, but the average price per ton is the lowest, having fallen from 97 cents in 1914 to 85 cents in 1915, as shown in the following table:

Glass sand produced in the United States, 1902-1915.

Year.	Quantity. (short tons).	Value.	Average price per ton.
1902	943,135	$ 807,797	$0.86
1903	823,044	855,828	1.04
1904	858,719	796,492	.92
1905	1,060,334	1,107,730	1.04
1906	1,089,430	1,208,788	1.11
1907	1,187,296	1,250,067	1.05
1908	1,093,553	1,134,599	1.04
1909	1,104,451	1,163,375	1.05
1910	1,461,089	1,516,711	1.04
1911	1,538,666	1,543,733	1.01
1912	1,465,386	1,430,471	.97
1913	1,791,800	1,895,991	1.06
1914	1,619,649	1,588,030	.97
1915	1,884,044	1,606,640	.85

Molding sand reached its highest production in 1912 and then fell off during the two succeeding years. In 1915, however, there was a marked recovery. Foreign demand for vast supplies of machinery and munitions, requiring the casting of metal compelled the use of a much greater quantity of molding sand in 1915 than in 1914.

Molding sand produced in the United States 1904-1915.

Year.	Quantity. (short tons).	Value.	Average price per ton.
1904.....	3,439,214	$2,125,370	$0.62
1905.....	3,084,098	2,102,423	0.68
1906.....	3,371,103	2,063,151	0.61
1907.....	3,682,494	2,460,754	0.67
1908.....	1,980,677	1,342,802	0.67
1909.....	3,122,806	2,146,220	0.68
1910.....	3,636,167	2,431,254	0.67
1911.....	3,376,717	2,132,469	0.63
1912.....	4,485,380	2,718,726	0.61
1913.....	3,563,583	2,230,217	0.63
1914.....	2,751,209	1,756,383	0.64
1915.....	3,585,746	2,123,203	0.59

For the same reason the quantity of fire and furnace sand required for lining furnaces, for ladles used to contain molten metal, and for making runners for casting pig iron was 65 per cent greater in 1915 than in 1914. There was a decrease in the average price per ton, however, from 59 cents in 1914 to 34 cents in 1915.

PRODUCTION.

The following tables have been prepared by Mrs. L. L. Kimball, statistical clerk, from reports received from thousands of producers throughout the United States:

[Tables Omitted]

* * *

IMPORTS.

Sand valued at $96,754 was imported into the United States in 1915, as compared with imports valued at $139,675 in 1914, and at $172,257 in 1913. This is largely building sand brought to the United States as ballast or from Canada as a near source of supply but it includes a small quantity of French molding sand imported for making fine bronze castings.

GLASS-SAND LOCALITIES.

Because of the increase in the glass business and of the consequent large demand for glass sand, two lists of glass-sand localities in the United States are given herewith.

Localities where glass sand was reported as produced in 1915.

Arkansas: Ruddells.
California: Ione and Lake Majella.
Georgia: Howard and Lumber City.
Illinois: Millington, Oregon, and Ottawa.
Indiana: Coxville and Michigan City.
Iowa: Clayton.
Kentucky: Olive Hill.
Maryland: Robinson.
Massachusetts: Cheshire.
Michigan: Rockwood and Steiner.
Missouri: Crystal City, Klondike, Pacific, St. Louis, and Silica.
New Jersey: Cedarville, Millville, Penbryn, South Vineland, and Williamstown Junction.
Ohio: Austintown, Barberton, Dayton, Hartford, Howard, Macedonia, Massillon, Rockbridge, Silica, and Tobasco.
Oklahoma: Hickory, Oklahoma City, and Roff.

Pennsylvania: Berne, Bingham, Caln, Daguschonda, Derry, Dunbar, Falls Creek, Hamilton, Kennerdell, Mapleton, Newton, Reading, Ridgeway, St. Marys, and Vineyard.
South Carolina: Blackville.
Virginia: Bristol and Mendota.
West Virginia: Berkeley Springs, Buckhannon, Hinton, Independence, Sturgisson, Terra Alta (Holmes Station), and West Berkeley.

Localities where glass sand occurs.

Alabama: Jefferson County, from crushed sandstone at Gates City; Etowah County, Gadsen.
Arkansas: Izard County, Guion and Ruddells; Jefferson County, Pine Bluff; St. Peter sandstone along valley of White River from Batesville nearly to Fayetteville, probably will make excellent glass sand.
California: Almeda County; Tesla; Amador County, Ione; Los Angeles County, Palmdale; Monterey County, Pacific Grove; San Joaquin County, near Stockton.
Delaware: Newcastle County, Christiana.
Florida: Escambia County, dunes at Pensacola; probably occurs at other places in State.
Georgia: Crawford County, Zenith; Montgomery County, Lumber City; Richmond County, dredged from Savannah River at Augusta; Taylor County, Butler, and Howard.
Illinois: Bond County, Greenville; Calhoun County, Cap au Iris; Kendall County, Millington; LaSalle County, important quarries in St. Peter sandstone at Ottawa, Utica, and Wedron; Lee and Ogle counties, along Rick River.
Indiana: Blackford County, Montpelier; Floyd County, New Albany; Fountain County, near Hillsboro; Green County, Johnson; Hamilton County, Lapel; Harrison County, Depauw; La Porte County, Michigan City;

Madison County, Pendleton; Martin County, Loogootee; Parke County, Corville; White County, Welcott.
Iowa: Allamakee County, abundant in St. Peter Sandstone; Clayton County, Clayton; Johnson County, River Junction; Linn County, Cedar Rapids.
Kansas: Montgomery County, near Caney and Independence, friable sandstone in Buxton formation in suitable quality; Wilson County, Fredonia.
Kentucky: Calloway County, in hills bordering Beechy Creek; Carter County, Lawton and Olive Hill; Hardin County, Tip Top; Kenton County, Ludlow.
Maine: Knox County, Camden; Waldo County, Liberty.
Maryland: Anne Arundel County, Robinson, Magothy River; Baltimore County, Catonsville; Washington County, Rock Forge; also in Cecil, Harford, and Kent counties.
Massachusetts: Berkshire County, made from granular quartzite at Cheshire and Washington; Dukes County, Tertiary sands at Gay Head and Marthas Vineyard.
Michigan: Monreo County, near Steiner; Wayne County, near Rockwood.
Mississippi: Hinds County, at Bryam, Jackson, and elsewhere along Pearl River; Jackson County, Horn Island; Tisboringo County, large deposit 1 mile from Tennessee River.
Missouri: St. Peter sandstone suitable for glass sand outcrops in a belt from a thin strip to 20 miles wide along Mississippi River from Ralls County to Cape Girardeau County and also up Missouri River as far as Calloway County. Important quarries: Franklin County, Becker, Gray Summit, and Pacific; Jefferson County, Crystal City and Silica; St. Charles County, Klondike.
Nevada: Ormaby County, 4 miles from Carson.
New Jersey: Camden County, Penbryn, Williamstown Junction, and Wilton; Cumberland County, Cedarville, Millville, and South Vineland; Gloucester County, Williamstown; Middlesex County, Jamesburg.

New York: Oneida County, Durhamville; Oswego County, Cleveland and Minetto; Schenectady County, Niakayuna; Ulster County, sandstone at Ellenville.

Ohio: Sandstones of Silurian or carboniferous age quarried and crushed; Erie County, Sandusky; Hocking County, Rockbridge; Knox County, Howard; Licking County, Tobasco; Lucas County, Sylvania; Mahoning County, Austintown; Muskingum County, Zanesville; Perry County, Chalfants; Stark County, Massillon; Summit county, Barberton, Macedonia, and Warwick; Trumbull County, Hartford and Niles; Tuscarawas County, Dundee.

Oklahoma: Arbuckle Mountains, sandstone of Simpson formation; southeastern Oklahoma north of Red River, Trinity sand; Cherokee County, St. Peter sandstone near Tahlequah.

Pennsylvania: Berks County, Berne and Reading; Chester County, Calp; Clearfield County, Falls Creek; Elk County, Daguscahonda, Ridgeway, and St. Marys; Fayette County, Dunbar, and along Monongahela River near Belle Vernon; Huntingdon County, Mapleton; McKean County, Bingham; Mifflin County, Hamilton, Newton, and Vineyard; Venango County, Kennerdell and Rochmere Station (near Oil City); Westmoreland County, Derry.

South Carolina: Barnwell County, Blackville and Ulmers; Clarendon County, Pee Dee.

South Dakota: Meade County, Unkpapa sandstone on Elm Creek.

Tennessee: Anderson County, Coal Creek; Benton County, abundant friable sandstone; Blount County, Chilhowee; Hardeman County, Saulsbury; Knox County, Knoxville; Montgomery County, abundant friable sandstone; Sullivan County, 20 miles from Bristol.

Texas: Grayson County, Denison.

Vermont: Bennington County, East Dorset, disintegrated quartz once used; Windsor County, Plymouth.

Virginia: Fine white sand of suitable quality occurs along eastern edge of middle Valley region –Amherst County, Stapleton Mills; Augusta County, Greenville; Rockbridge County, Balcony Falls, along west base of Blue Ridge; Roanoke County, Catawba Mountain, 9 miles northwest of Salem; Washington County, Bristol and Mendota.

West Virginia: Monongalia County, Sturginson; Morgan County, Berkeley Springs; Preston County, Holmes Station, near Independence; Randolph County, Silica; Taylor County, Grafton; Upsbur County Buckhannon, Craddock.

Wisconsin: Columbia County, Protage; Monroe County, Tomah; Rock County, Beloit; St. Peter sandstone in many localities as at Waukau, Winnebago County.

Wyoming: Albany County, soft sandstone, 3 miles east of Laramie.

WEIGHT OF SAND AND GRAVEL PER CUBIC YARD.

The production of sand and gravel is reported by the survey short tons, but some of it is reported to the Survey in cubic yards so that it has been necessary to make inquiry of the producers as the weight of the cubic yard of sand and gravel sold by them in order to convert their figures into tons. The result of this inquiry is a determination for the whole country of an approximate average weight per cubic yard of 2,665 pounds for sand and of 2,820 pounds for gravel. According to the reports of 670 producers of sand and of 560 producers of gravel who reported to the Geological Survey in cubic yards instead of tons, the weight of a cubic yard of sand varies from 2,200 pounds to 4,000 pounds and the weight of cubic yard of gravel from 2,200 pounds to 4,200 pounds. Any weight above 3,300 pounds a cubic yard for sand is very unusual,

for of the 670 producers replying to the question, only 12 reported above that weight and only 22 reported above 3,000 pounds. It is surmised that the sands reported as weighing over 3,000 pounds were weighed wet, or that the reported weight was only a guess, or that the composition was unusual; for a cubic yard of pure quartz closely packed should weigh 3,240 pounds.

It may be that many of the weights reported to the Survey are guesses and not actual determinations, but even if this is so the expression of opinion of several hundred producers should give a very fair average weight. The average weights of sand and gravel in those States in which 10 or more producers reported figures are as follows:

Reported weights of sand and gravel to the cubic yard, in pounds.

State.	Sand.	Gravel.
Alabama	2,505	2,790
California	2,645	2,895
Florida	2,605	2,680
Illinois	2,820	3,005
Indiana	2,700	2,945
Iowa	2,720	2,850
Kentucky	2,580	2,830
Massachusetts	2,710	2,810
Michigan	2,895	2,985
Minnesota	2,865	2,880
Missouri	2,680	2,840
New Jersey	2,600	2,730
New York	2,590	2,760
Ohio	2,700	2,830
Oregon	2,620	2,880
Pennsylvania	2,500	2,680

Texas	2,695	2,910
Washington	2,930	3,065
West Virginia	2,570	2,780
Wisconsin	2,800	2,970

It is noticeable that the highest average weights for both sand and gravel are shown by Illinois, Michigan, Minnesota, Washington, and Wisconsin. If there is any special significance to this it is not apparent to the writer.

The figures given above for Illinois, Indiana, Iowa, Michigan, New York, Ohio, and Wisconsin are averages from the reports of 30 to 65 producers; the averages for the other States are from fewer producers. A cubic yard of sand of spherical grains of uniform size and a cubic yard of gravel of the same mineral composition and consisting of round pebbles, all of the same size, should have the same weight, for the pore space would be equal and about 27 per cent of the volume.

There are two principal reasons, however, why gravel weighs more than the same volume of sand. One is the difference in mineral composition, and the other the greater variation in size of component parts. Gravel is commonly composed of rock fragments which contain quartz, feldspar, and ferromagnesian minerals; quartz is the least soluble of these and forms the greater part of most sands, the heavier and more easily disintegrated minerals being reduced to silt. Sand, therefore, as a usual thing, is lighter than the gravel from which it is derived because the lighter mineral forms a greater percentage of the whole. Second, sand is comparatively even-grained and, therefore, has considerable pore space, while the ordinary run of unsized gravel has a wide range in size of individual pebbles, which results in a considerable reduction

in pore space. It is largely the lack of close sizing that gives ordinary gravel a greater weight per unit of volume than the same volume of sand.

In connection with the discussion now going on among dealers as to the advisability or advantage of selling sand and gravel by weight rather than by volume, attention is directed to the results of laboratory tests on sands derived from 19 different localities in western Washington, kindly furnished to the Survey by the analyst, Mr. R.J. Borhek, of Tacoma, Wash. Samples of sand were thoroughly dried, poured into a cylinder having a capacity of one-fifth of a cubic foot, shaken until settling ceased, and then weighed. The weights computed for a cubic yard range from 2,692 to 3,164 pounds, the average being 3,020 pounds for 19 samples. On comparing this with the average of 2,930 pounds per cubic yard derived from the reports of 10 dealers in the same area, whose estimates ranged from 2,500 to 3,200 pounds per cubic yard, the suggestion at once arises that the consumer who buys sand by the cubic yard may be getting nearly 100 pounds more per yard than the dealer estimates. It is obvious, however that the consumer is at a disadvantage in purchasing sand by weight if the material has not been dried and kept under cover, and most sand is not so treated. A yard of building sand would weigh more when it was just pumped from the river than after it had drained and dried on the dock, or more after a shower than after a day in the sun. Furthermore, weighing causes a slight loss of time in delivery. The sale of sand and gravel by the yard, on the other hand, is haphazard, for wagon boxes vary in capacity, the exact capacity is not known to the loader, and one load may be heaped higher than another.

CHATS.

The tables of production given above do not include a considerable quantity of chats or tailings from the Missouri zinc mines. This waste product, which is used on roads, has a nominal value of 10 cents a ton, or the cost of loading. The shipment of chats in Missouri in 1915, as reported by the Missouri Bureau of Geology and Mines, was 2,309,191 tons, compared with 2,270,771 tons in 1914.

[Attached to Defendants' Brief in Support of Mineral Ownership and in Opposition to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 26)]

DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

MINERAL RESOURCES

OF THE

UNITED STATES

1916

H.D. McCASKEY
Geologist in Charge, Division of
Mineral Resources

PART II – NONMETALS

E.F. BURCHARD and G.F. LOUGHLIN,
Geologists in Charge

[SEAL]

WASHINGTON
GOVERNMENT PRINTING OFFICE
1919

SAND AND GRAVEL

By R. W. STONE.

TRADE CONDITIONS.

In 1916 the production of sand and gravel was unprecedentedly large. All kinds of sands increased in total value, and most of them increased in quantity, in spite of the fact that car and labor shortage limited the output of many sand and gravel pits. From many parts of the country it was reported by producers that they could not get enough men to operate at the desired capacity or enough cars to meet their requirements.

In 1915 for the first time a tabulation was made of the condition of the sand and gravel industry as reported in those States having the largest number of producers. Only a small proportion of the thousands of producers of sand and gravel who report annually to the United States Geological Survey answer the question as to their business condition compared with that of the preceding year. Of the 663 producers in six States who reported on the condition of the business in 1915, 281, or 42 per cent, said that the situation was better than in 1914, and 219, or 33 per cent, said it was worse. In 1916 a much larger number replied to this question. In the 838 answers from six States, 54 per cent reported business as better than in 1915, and only 22 per cent reported it worse. A tabulation of these reports on business conditions follows:

Firms reporting condition of sand and gravel industry in 1916 in comparison with 1915.

State.	Better.	Same.	Worse.
Illinois	62	38	24
Indiana	62	30	19
Michigan	92	39	75
New York	55	9	24
Ohio	96	42	19
Pennsylvania	88	36	28
	455	194	189

The tendency toward larger business as shown in this table, the evidence of increased output given in tables on the following pages, and the trend of business in the summer of 1917 indicate that the production of sand and gravel in 1917 will far exceed in quantity and value the production of any previous year.

PRODUCTION.

The tables for 1916 have been prepared by Mrs. L. M. Beach, statistical clerk, from reports received from thousands of producers throughout the United States. Were it not for the fact that many producers delay sending in their reports until June or July, this information would be published much earlier in the year.

[Tables omitted.]

* * *

It is believed that the production in 1917 will be considerably greater and that the average price per ton will exceed $1, as an increased output is promised by larger demands and new uses for glass. As a structural

material glass has an increasing use – for example, in the larger window area demanded in new office, factory, and school buildings. A new use for glass is in making coffins. A glass coffin molded in one piece, with a hermetically sealed cover, takes the place of a wooden coffin and a steel or slate vault.

GLASS-SAND LOCALITIES.

The resources of the United States in sand suitable for making the more common kinds of glass are very great. Eighteen States produced glass sand in 1916, and it occurs in other States in numerous localities.

Localities where glass sand was reported as produced in 1916.

California: Ione and Lake Majella.
Georgia: Lumber City.
Illinois: Millington, Oregon, and Ottawa.
Indiana: Michigan City.
Iowa: Clayton.
Kentucky: Olive Hill.
Louisiana: Opelousas.
Maryland: Robinson and Hancock.
Massachusetts: Cheshire.
Michigan: Steiner.
Missouri: Crystal City, Klondike, Pacific, and Silica.
New Jersey: Bordentown, Cedarville, Jamesburg, Millville, Penbryn, South Vineland, and Williamstown Junction.
New York: Cleveland.
Ohio: Austintown, Barberton, Howard, Massillon, New Lexington, Silica, and Toboso.
Oklahoma: Hickory, Oklahoma City, and Roff.
Pennsylvania: Daguscahonda, Derry, Dunbar, Falls Creek, Hamilton, Kennerdell, Lewistown, Mapleton, Newton, Parrish, Ridgeway, St. Marys, Torpedo, and Vineyard.
Texas: Santa Anna.

West Virginia: Berkeley Springs, Buckhannon, Independence, Sturgisson, Terra Alta (Holmes Station), and West Berkeley.

REQUIREMENTS OF GLASS SAND.

The factors which determine the value of a deposit for making glass are chemical purity, physical character, quarrying conditions, and location with respect to transportation, cheap fuel, and market.

Glass is a transparent impermeable substance formed by fusing sand, or silica, with fixed alkalies. It is made by melting the ingredients in a pot or tank, mixing the batch thoroughly, and allowing it to cool. It is molded into the desired form while molten. Sand is the principal constituent of all glass, comprising from 52 to 65 per cent of the mass of the original mixture. The qualities of the glass, such as lack of color, brilliance, transparency, and hardness, depend largely, therefore, on the quality of the sand.

For the finest ware only the purest quartz (silica) sand can be employed because slight impurity, especially a small quantity of iron, impairs the brilliance, whiteness, and clearness. Thus, for the manufacture of glass for optical instruments, which is practically colorless, sand, or ground silica, should contain not more than 0.015 per cent of ferric oxide. Plate and window glass are commonly pale green and absolute purity is not essential in the sand, but more than 0.2 per cent of ferric oxide is undesirable. Green and amber glass for rough structural work, as skylights, sidewalk lights, for bottles, jars, and insulators, are made from sand that has more impurity than is permissible in sand for plate glass and prescription ware.

The suitability of a sand for making glass may be determined roughly by inspecting it for the following properties: The sand should consist almost entirely of quartz, or silica (most glass sands contain from 98 to more than 99 per cent of silica); it should be nearly white or easily washed white; the grains should be uniform in size, either angular or rounded, and preferably should not be larger than 20 mesh nor smaller than 80 mesh. Whiteness is not essential, however, in sand for ordinary window glass and cheap bottles and jars. Sand for window glass that has been dug at a New York locality for many years is pink or dark flesh-colored, and an Indiana sand used for making beer bottles is drab, because of a coating of clay on each of the colorless quartz grains.

Most of the glass sand produced in this country is obtained by crushing soft, crumbly sandstones, but where power is very cheap, it is practicable to produce glass sand by crushing quartzite and vein quartz.

Methods of quarrying and preparing the sand vary somewhat, but in general the quarry face is drilled and shot down with an explosive, and the coarse and fine material is delivered to the mill. If a special quality of sand is desired, selection may be made at the quarry by hand sorting. Large lumps, if very hard, are reduced by a jaw or rotary crusher, but in most places by a less powerful machine, such as a pug mill or muller or a crusher consisting of many heavy hammers revolving rapidly.

Washing the crushed sand is done by two common methods. By one method the sand is carried first upward by a screw conveyor through a long, narrow inclined box against a descending stream of water and then downward in a narrow chute by a second stream of water. This

process is repeated three or four times, after which the sand is spilled on a belt conveyor and carried to the draining piles. Another method of washing is by settling tanks. A stream of sand and water is discharged into a tank where the sand settles and impurities are drained off. Sand washed by this method may be left in the last tank to drain, or it may be carried to a draining pile. Sand carried away by the wash water in either process is caught in settling ponds or yards outside the mill and may be used for the various purposes to which a fine-grained silica sand is adapted.

After draining for several hours, or days, the sand is dried, either rapidly in rotary cylindrical driers heated by gases from coke or other smokeless fuel, or slowly by settling through coils of steam pipes, and is then screened and put in stock bins. Glass sand is shipped in bulk in box cars, which are lined with paper to prevent leakage.

MOLDING SAND.

GENERAL ASPECTS OF THE INDUSTRY.

Under molding sand are included iron, steel, and brass molding sand, core sand, and pig-bed sand.

The effect of the war in Europe on the molding-sand industry in the United States is very apparent. Reports of production made to the United States Geological Survey show an increase of 30 per cent in 1916 over 1915. This great increase was caused by the demand for vast supplies of machinery and munitions for shipment abroad and also for manufacturing and mining machinery for domestic use, all of which required molding sand for casting the metal. The production in 1916 exceeded 4,500,000 tons for the first time and the average price per ton, 69 cents, was the

highest yet recorded. The following table shows the fluctuations of the industry since 1910:

Molding sand produced in the United States, 1910-1916.

Year.	Quantity (short tons).	Value.	Average price per ton.
1910	3,636,167	$ 2,431,254	$0.67
1911	3,376,717	2,132,469	.63
1912	4,485,380	2,718,726	.61
1913	3,563,583	2,230,217	.63
1914	2,751,209	1,756,383	.64
1915	3,585,746	2,123,203	.59
1916	4,662,649	3,219,839	.69

Ohio was the leading State in the production of molding sand; Pennsylvania was second, and New York, New Jersey, and Illinois, in the order named, were the next largest producers. These States are also the largest producers of iron and steel castings, for which the molding sand is used.

SUBSTITUTE FOR FRENCH MOLDING SAND.

Molding sand produced at Fontenay aux Roses, near Paris, France, has been imported for r any years for bronze and brass workers. The annual importation is believed to have been about 1,000 casks of 800 pounds weight. The sand is yellow and lumpy and has to be ground and mixed for use. When so prepared it is comparatively even-grained and readily passes a 100-mesh sieve. It is composed almost wholly of quartz, and the grains are mostly subangular, translucent to iron-stained, rarely transparent. This sand has a most durable and

tenacious natural bond and is permeable to gases even when packed. It is used for facing molds for fine bronze castings, particularly statuary and tablets in relief.

Many of the bronze molders in this country are Frenchmen, who have a natural preference for the sand with which they learned their trade. The European war has practically stopped the importation of French sand. The United States Geological Survey, in trying to find a domestic substitute, has discovered that a sand which promises to be satisfactory occurs at West Albany, N. Y., and at Zanesville, Ohio.

Of the West Albany sand, a firm of bronze molders who had been using French sand exclusively wrote: "This sand proved to be just what we wanted." The Zanesville sand is slightly finer grained than the French sand and according to the Bureau of Standards melts at 1,580° C., or 70° lower than the melting point of French sand. After a little experience in their use the molders should be able to get satisfactory results with either of these sands.

BUILDING SAND.

Building sand is used for making plaster, mortar, and concrete. Wall and ceiling plaster, whether made of lime or gypsum, commonly contains a considerable quantity of sand, particularly in the base coat. Mortar used in laying brick, stone, and tile has a body of sand, and sand is a large constituent of much concrete. The reported production of building sand increases annually by reason of larger business and new names added to the list of producers. This sand probably is reported less completely than any other in the foregoing tables because its occurrence is common and widespread, and its use in small amounts by

thousands of individuals is not reported to the Survey. The individual use often is only a wagon load or a few tons, but the aggregate of these of which the Survey gets no record must be hundreds of thousands of tons. In many small villages throughout the United States there is no regular dealer in sand and whoever needs a supply gets it from a local deposit. This may be a privately owned sand pit from which the owner may derive a few dollars a year, or it may be the dry bed of a stream from which sand is taken without charge. Obviously the Survey is unable to get a record of this production.

The recorded production in 1916 was 27,193,462 short tons, valued at $8,569,675, an increase of 4,272,036 tons and of $1,685,408 over the production in 1915.

GRINDING AND POLISHING SAND.

Grinding and polishing sands are sharp, tough, hard sands free from clay or foreign material, and sized for use in sawing, cutting, and polishing stone, for grinding and etching glass, and for cleaning metal castings by means of a blast. Blast sand may be either round or angular grains. Pennsylvania is the largest producer and probably the largest user of these sands.

The total production of grinding, polishing, and blast sand in 1916 was 1,370,354 short tons, valued at $889,651. This was an increase of about 40 per cent in quantity and 100 per cent in value over the production of 1915.

FIRE OR FURNACE SAND.

Pennsylvania was the largest producer of fire or furnace sand, which is a highly refractory silica sand used for lining and patching reverberatory and other furnaces, cupolas, and ladles used to contain molten metal. It is also used for making runners for pig-iron casting. Although the quantity produced in 1916 as reported to the Survey was less than in 1915, the total value was more than double that of the earlier year. The average price per ton in 1915 was about 34 cents; in 1916 it was 90 cents, and considerable quantities brought well over $1 a ton.

OTHER SANDS.

There seems to have been a slight decrease in the quantity of engine sand used in 1916 but an increase in total value. Paving sand showed a marked increase in both quantity and value. Filter sand, a clean silica sand in sorted sizes used for beds in water-filtration plants and in small mechanical filters, is here reported separately for the first time. The production, as shown in the table on pages 332-333, was largely in Iowa and New Jersey.

In the reports of former years railroad ballast sand has been reported separately and railroad ballast gravel has been lumped with gravel for roofing, concrete, and paving under the one head "Gravel." In tabulating the production of 1916 sand and gravel used for railroad ballast were put together for the reason that much of this ballast is a mixture of sand and gravel and not distinctly one or the other. The change results in much larger figures for railroad ballast and decreases the reported production of gravel by several million tons.

The grand total of sand and gravel produced in the United States in 1916 shown an increase of more than 12,000,000 short tons and in value of more than $6,600,000.

CHATS AND VOLCANIC ASH.

The tables of production given above do not include a considerable quantity of chats or tailings from the Missouri zinc mines. This waste product, which is used on roads, has a nominal value of 15 cents a ton, or the cost of loading. The shipment of chats in Missouri in 1916, as reported by the Missouri Bureau of Geology and Mines, was 2,890,970 tons, compared with 2,309,191 tons in 1915.

Neither do the tables include a considerable quantity of volcanic ash mined and used in California for railroad ballast. This material weighs 2,400 pounds per cubic yard, was valued at $967, and is not included in the tables of other chapters of Mineral Resources for 1916.

[Attached to Defendants' Brief in Support of Mineral Ownership and in Opposition to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 26)]

DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

MINERAL RESOURCES

OF THE

UNITED STATES

1917

H.D. McCASKEY
Geologist in Charge, Division of
Mineral Resources

PART II – NONMETALS

G. F. LOUGHLIN, Geologist in Charge

[SEAL]

WASHINGTON
GOVERNMENT PRINTING OFFICE
1920

SAND AND GRAVEL

By R. W. Stone.

INTRODUCTION.

To many people sand is used most commonly for mortar and plaster in building operations, and gravel for concrete and railroad ballast. Were these their only uses the sand and gravel industry would be large but not widely interesting. Sand and gravel are employed in many other ways, however. It is well known that sand and gravel are widely distributed, abundant, and much used in the United States, but their vital importance in the economy of the Nation was scarcely appreciated until war made unusual conditions and demands. The demand has been so great in recent months that in some places on the Atlantic coast sand and gravel have almost attained the status of war minerals. At certain shipbuilding and camp sites there is no gravel readily available and sand suitable for building is scarce. Sand dunes may be abundant, but the grains are too small. So great has been the demand for sand and gravel in large Government construction work that this common and cheap building material has been shipped considerable distances. It is understood that for some of the building recently done near Norfolk, VA., where the supply is inadequate, the sand and gravel were brought from New York, a distance of 300 miles, by sea in coal barges that otherwise would have returned empty; hence the cost of transportation was small.

Only four natural nonmetallic minerals produced in the United States – not including clay products and

cement (manufactured products) – show a greater annual value than that of sand and gravel; these are petroleum, natural gas, coal, and stone. The production of sand and gravel in 1917 was valued at more than $35,000,000. This is an undervaluation, for the list of producers is notably incomplete and it has not been possible to get reports from numerous producers who dig small quantities intermittently for local use.

The statistics in the following tables more nearly represent the actual output of the industry than the reports of previous years, as the list of producers known to the Geological Survey is constantly increasing. It must be admitted, however, that the statistics are incomplete, as there are some States in which almost no producers are known and in all States sand and gravel are produced for local use in hundreds of villages, of which no information is obtained and the aggregate quantity of which must be large.

Most of the producers fill out reports in correct form, and this is especially true perhaps of the members of the National and State associations, for they keep accurate and detailed records of their business and appreciate the importance and use of these statistical data. There are other producers, however, who report sand sold for building in the space provided for glass sand and perhaps give no figures for value. In such cases, if the geologist knows that the material at the locality given is not suitable for making glass, he must write to the producer calling attention to the error and asking for what purposes the sand was actually used and the value of it. When no reply is received, as sometimes happens, it is impossible to give accurate classification. All too frequently producers fail to report value, and the writer is obliged to estimate. If all

producers knew how great is the demand by various Government boards and other organizations for exact information as to producers and production of sand and gravel in different localities, this appeal for better reports, mailed promptly early in the year, would probably not be necessary. At the late date at which this report is being written (August 29), after many needless delays, a card reporting more than 8,000 tons of molding sand has been received, which necessitates changes in the tables. Such tardiness is one of the causes of delay in the publication of this report.

WAR USES.

The utility of sand and gravel has only to be mentioned to be appreciated, but to most people the great variety of their uses is unknown and their connection with war is unrecognized. Of course the largest quantity of sand produced in this country is that used by builders. Although the building operations in the large cities of the country were much less in 1917 than in 1916, in some localities there was an amazing increase in building. Among these large building operations may be mentioned cantonments, shipyards, and towns engaged in the manufacture of munitions and other war necessities. Sand and gravel are used in these structures, from the concrete piles and foundations placed in the ground to the mortar in the chimneys that rise above the gravel roofs. Other war-time uses of sand and gravel are mentioned in the following paragraphs.

Molding sand is used for casting molten metal and is of many kinds. There are three main classes – steel, iron, and brass molding sands. Each class includes several

varieties of sand, the particular variety used depending on the size and weight of the casting and the position occupied in the mold. It is easily seen how important these sands are in war time, when a nation is making great quantities of machinery and munitions requiring castings in all these metals. Sand is used for molding such diverse things as shrapnel and the bodies of gasoline engines, cannon and car wheels, and for making many other things intimately connected with the prosecution of war.

Steel-molding sand is a white or yellowish clean quartz sand high in silica. It has no bond, and in order to make a mold with it a small quantity of fire clay, molasses water, or other material is added for binder. The size of the sand grain varies with the work to be done. Iron-molding sand or foundry sand is siliceous sandy material used in foundries for making molds and cores for casting molten iron. It is usually of some shade of brown, may be clayey, loamy, or sandy, fine or coarse grained, and has strong bond when moist. From 3,000,000 to 5,000,000 tons is used annually. Brass-molding sand includes sand used for molding brass, bronze, and aluminum. This is a very fine grained sand with strong bond which will take sharp detailed impressions and give a smooth surface to the casting. Articles for war use cast in these metals are numerous.

The manufacture of glass might at first thought be considered a nonessential industry with relation to war, but no sooner did this Nation enter the conflict than there was found to be a shortage of optical glass for range finders, field glasses, cameras, and surveying instruments. The making of optical glass was undertaken by the Government in cooperation with existing glassworks. The sand required for this work is small in quantity but

important. How many people who are dependent on eyeglasses for clear vision are aware that sand is the principal component of the lenses? Sand composes 60 to 75 per cent of all glass, and more than 2,000,000 tons of glass sand was used in the United States in 1916. Glass is used in war for many purposes, ranging from plate glass for portholes and companionways on transport and battleships to cheap green-glass insulators for electric-transmission lines, from lenses in periscopes to electric-light bulbs and clinical thermometers. Fortunately for our large need, the supply of glass sand of all grades is abundant, and methods of making glass for optical use as well as for other purposes are now well understood.

Grinding, polishing, and blast sands have a part in the conduct of war in making smooth the rough places on metal, glass, stone, and other hard substances. Blast sand is clean tough sized sand, with either round or angular grains, which is driven by compressed air through a hose for such purposes as cleaning metal castings and dressing stone. In gun shops, locomotive and car shops, and most places where heavy metal castings are made the sand blast is used to clean off parts of the mold that adhere to the castings. The size of sand used is varied with the character of the duty to be performed.

Fire or furnace sand is highly refractory silica sand for lining furnaces and ladles used to contain molten metal and so has a place in all foundries. About 500,000 tons is used annually in the United States.

Military highways and railroads are built, ballasted, and repaired with sand and gravel. Many millions of tons of sand and gravel are used on the roads and railroads of this country, and readily available supplies of this material

enable the roads to support the heavy traffic in war time. Sand is carried on all locomotives to increase the friction on slippery rails and so plays a not unimportant part in transportation. Engine or friction sand reported annually as used in the United States amounts to about 1,230,000 tons. It must be dry and for best service should be fairly even grained, tough, and sharp.

Filter sand and gravel are fairly pure quartz free from dirt, dust, organic matter, or other impurities, sized, and containing not more than a very small percentage of soluble minerals. They are used for beds in water-filtration plants and in filters for other liquids. As the used sand does not wear out or deteriorate, practically all the demand, which is not large, is for new filters rather than for renewal. Water for some of our military camps passes through sand filters.

There are many other uses of sand, some closely and others more remotely connected with the activities on the battle front. Sand in bags is used for protecting buildings and works of art in cities under gun fire and for balloon ballast. Fine, clean sand is employed in the care of pigeons and canaries used as messengers and gas detectors in the trenches, and sand bags form the parapets of many lines of defense.

TRADE CONDITIONS.

Many sand and gravel producers in all parts of the country report that trade was much better in the first half of 1917 than in the second half. The entry of the United States into the world war in April, 1917, and the consequent temporary unstable business conditions, followed by Government restrictions of shipping, resulted in a decreased

production in sands for some uses, especially for buildings and roads, toward the end of the year. The scarcity and cost of labor and coal and the shortage of freight cars seriously impeded the production of sand. The larger producers in several of the Eastern States agree that the demand was the greatest ever experienced, but the sales were restricted by the above-mentioned conditions.

A tabulation of 736 reports from producers in six leading States shows that of this number 353, or 48 per cent, considered business conditions better in 1917 than in 1916, 24 per cent saw no change, and 28 per cent handled less material. In Ohio and Pennsylvania the trade was especially brisk.

PRODUCTION.

In 1917 the total quantity of sand and gravel produced was 76,119,325 short tons, valued at $35,296,932, as compared with 89,091,732 tons in 1916, valued at $29,809,995.

The tables for 1917 have been prepared by Mrs. L. M. Beach, statistical clerk, from reports received from about 2,300 producers throughout the United States.

[Tables omitted:]

* * *

GLASS SAND.

GENERAL ASPECTS OF THE INDUSTRY.

Although the quantity of glass sand produced in the United States passed the 2,000,000-ton mark in 1916, it fell below that mark in 1917. The production was greater, however, than in any year previous to 1916. The value of

the total output, on the other hand, increased largely, exceeding $2,500,000, although in no previous year had it reached $2,000,000. The average price per ton in the last seven years has ranged from $0.85 to $1.06, but in 1917 it rose to $1.38, owing to the increased cost of labor, machinery, and fuel.

The principal producers of glass sand in order of output are Illinois, Pennsylvania, West Virginia, Ohio, Missouri, and New Jersey.

Glass sand produced in the United States, 1910-1917.

Year.	Quantity (short tons).	Value.	Average price per ton.
1910	1,461,089	$1,516,711	$1.04
1911	1,538,666	1,543,733	1.01
1912	1,465,386	1,430,471	.97
1913	1,791,800	1,895,991	1.06
1914	1,619,649	1,568,030	.97
1915	1,884,044	1,606,640	.85
1916	2,018,317	1,957,797	.97
1917	1,942,675	2,685,014	1.38

GLASS-SAND LOCALITIES.

The resources of the United States in sand suitable for making the more common kinds of glass are very great. Twenty States produced glass sand in 1916, and it occurs in other States in numerous localities.

Localities where glass sand was reported as produced in 1917.

Arkansas: Ruddells.
California: Ione and Lake Majella.
Georgia: Lumber City.
Illinois: Millington, Oregon, and Ottawa.
Indiana: Michigan City.
Iowa: Clayton.
Kentucky: Olive Hill.
Louisiana: Opelousas.
Maryland: Robinson.
Massachusetts: Cheshire.
Missouri: Crystal City, Klondike, Pacific, and Silica.
New Jersey: Cedarville, Millville, Penbryn, South Vineland, and Williamstown Junction.
New York: Cleveland.
Ohio: Austintown, Barberton, Howard, Massillon, New Lexington, Silica, and Toboso.
Oklahoma: Hickory, Oklahoma City, and Roff.
Pennsylvania: Daguscahonda, Derry, Dunbar, Falls Creek, Kennerdell, Lewistown, Mapleton, Ridgeway, St. Marys, Torpedo, and Vineyard.
Tennessee: Lagrange.
Texas: Santa Anna.
Virginia: Sandberg.
West Virginia: Berkeley Springs, Buckhannon, Independence, Sturgisson, Terra Alta (Holmes Station), and West Berkeley.

MOLDING SAND.

The molding-sand industry has reached such volume that the decrease of 1,681 tons from the production of 1916, as shown in the following table, is negligible. This small quantity may be covered by the failure of one producer to report, or it may be silica sand reported as foundry sand

which might have been credited either to steel-molding sand or to furnace sand. The great increase in total value and in the average price per ton from 69 cents to 92 cents, or 33 per cent, is notable.

Molding sand produced in the United States, 1910-1917.

Year.	Quantity (short tons).	Value.	Average price per ton.
1910	3,636,167	$2,431,254	$0.67
1911	3,376,717	2,132,469	.63
1912	4,485,380	2,718,726	.61
1913	3,563,583	2,230,217	.63
1914	2,751,209	1,756,383	.64
1915	3,585,746	2,123,203	.59
1916	4,662,649	3,219,839	.69
1917	4,660,968	4,303,809	.92

Ohio was the leading State in the production of molding sand, as in 1916. Pennsylvania, however, dropped from second to fourth place, Illinois becoming second and New York third in order of production.

BUILDING SAND.

The recorded production of building sand in 1917 was 25,374,987 short tons, valued at $9,837,688, a decrease of 1,818,475 tons in quantity and an increase of $1,268,013 in value. It is presumed that there will be a greater decrease in production of building sand in 1918 because of the restrictions on building throughout the country.

Although there is a very large increase in the production of sand and gravel for building in some localities, particularly at isolated places where large Government construction work is in progress, it is believed that this will not counterbalance the decrease through the country as a whole. It is freely predicted that after the war there will be a great deal of building and that the production of sand and gravel for this purpose will materially increase.

New York led in the production of building sand in 1917, with an output of more than 3,800,000 tons; Illinois was second, with 2,500,000 tons; and Ohio and Pennsylvania ranked third and fourth.

GRINDING AND POLISHING SAND.

The total production of grinding, polishing, and blast sand in 1917 was 1,179,190 tons, or only a little less than in 1916. There was, however, a very considerable increase in value, the total amount being $1,220,708, as compared with $889,651 in 1916. The average price per ton for all sands under this head was 65 cents in 1916 and $1.04 in 1917. Pennsylvania, Illinois, New Jersey, and New York were the leading producers in the order named.

FIRE OR FURNACE SAND.

The total production of fire or furnace sand in 1917 was 604,035 tons, valued at $695,455, as compared with 426,654 tons, valued at $384,738, in 1916. Pennsylvania, Ohio, New Jersey, and Illinois were the largest producers. The average price per ton was 34 cents in 1915, 90 cents in 1916, and $1.15 in 1917.

OTHER SANDS.

There was a slight increase in the quantity of engine sand reported, and a large increase in value, caused by an increase in average price from 37 cents in 1916 to 59 cents in 1917. Pennsylvania reported by far the largest production, or more than three times that of Illinois, which ranked second. Paving sand showed an increase in both quantity and value and would have been reported in larger quantity had not the use of freight cars for transporting sand and gravel been restricted in the later part of the year. Filter sand, reported separately for the first time in 1916, fell off in 1917, the production being 62,170 tons, valued at $47,351, as compared with 76,053 tons, valued at $68,340, in 1916. There was a small reduction in both quantity and value of railroad ballast reported to the Survey, and a reduction of about 7,000,000 tons in quantity of gravel produced for all purposes, but the total value of gravel produced was more than $1,300,000 greater than in 1916.

CHATS AND CHERTS.

The tables of production given above do not include a considerable quantity of chats or tailings from the Missouri zinc mines. This waste product, which is used on roads, has a nominal value equal to the cost of loading. The shipments of chats in 1917, as reported by the Missouri Bureau of Geology and Mines, amounted to 1,426,716 short tons, compared with 2,890,970 tons in 1916. Of these shipments in 1917, 1,055,972 tons were from mines in southwestern Missouri and 370,744 tons from mines in southeastern Missouri. More than 1,000,000 tons of this material is believed to have been used for

railroad ballast, and the rest for other purposes, such as road metal and concrete.

Neither do the tables include between 13,000 and 20,000 tons of chert dug in Alabama and valued at more than $11,000.

IMPORTS.

Sand valued at $142,586 was imported into the United States in 1917, as compared with imports valued at $87,144 in 1916. This is largely building sand brought to the United States from Canada as a near source of supply or brought as ballast from overseas. The imports usually include a small quantity of French molding sand used for making fine bronze castings, refractory sand from England for lining certain iron furnaces, and sands adapted to special uses and brought in small quantity. This importation of sand from abroad is for the most part nonessential but is done because molders, foundrymen, or others of foreign birth learned their trade with a foreign sand and are averse to using other sands than those with which they are familiar.

EXPORTS.

In 1916 for the first time the value of the exports of sand and gravel were recorded separately by the Bureau of Foreign and Domestic Commerce. The table given herewith has been prepared by J. A. Dorsey, of the Survey, from the tables published by that bureau. No information is at hand as to the quantity of sand and gravel represented by these figures nor as to the character and use of the material. Building sand went to Canada from the Great Lakes and Canadian boundary rivers as a convenient

source; the character of the material sent to other countries is not known to the writer.

Value of sand and gravel exported from the United States in 1916-17.

Destination.	1916	1917
Denmark	$300	.....
Spain	420	.....
England	775	$7,136
Canada	196,001	415,699
Panama	8,190	33,941
Mexico	7,011	16,892
Newfoundland	1,943	1,039
Cuba	1,519	1,743
Argentina	600	6
Brazil	1,029	226
China	428	217
Japan	2,554	5,951
Other countries	12,540	11,401
	233,310	494,251

[Attached to Defendants' Brief in Support of Mineral Ownership and in Opposition to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 26)]

DEPARTMENT OF THE INTERIOR
ALBERT B. FALL, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

MINERAL RESOURCES

OF THE

UNITED STATES

1918

G. F. LOUGHLIN
Geologist in Charge, Division of Mineral Resources

PART II – NONMETALS

R. W. STONE, Geologists in Charge

[SEAL]

WASHINGTON
GOVERNMENT PRINTING OFFICE
1921

SAND AND GRAVEL

By R. W. STONE.

INTRODUCTION.

The task of the Geological Survey in collecting the statistics of the production of sand and gravel in the United States has proved very difficult. The small dealers not infrequently are reluctant to give the quantity and value of their output, and many of the new producers do not realize the purpose of the Survey's work. This reluctance to furnish complete or satisfactory information is often due to the desire of the producer to keep all knowledge of his business from his competitors. He does not realize that the statistics of any particular individual or firm are held in strict confidence by the Survey and are not given out except by his special permission. The small independent producer should use every legitimate effort to foster his own enterprise, especially when he is surrounded by competitors, but it is to his interest that he and his business be known to the Survey, which may be able to turn more business his way.

In all statistical work the completed totals can be no better than the individual reports. If a man or a firm here and there fails to give the figures showing production and value, or makes erroneous statements, the accuracy of the tabulated statistics is to that extent impaired.

The work done by the United States Geological Survey in connection with sand and gravel is not confined to the tabulation and publication of the statistics of production. Information concerning these products is constantly being

sought and compiled and is freely given to any inquirer. An engineer in New York may want a grade of sand that is especially fitted for some particular work there or elsewhere and may ask what source of supply is nearest to his project. The Survey promptly puts him in touch with the firm or firms that can best supply him sand in the quantity and of the quality he desires. A builder who is far from any source of gravel known to him and who wants to save both time and freight charges in obtaining his supply of gravel asks the Survey for information; or someone forwards to the Survey a sample of sand to learn its use and value and its possible buyers. The Survey tries to help each inquirer, thus benefiting both the producers and the consumers.

PRODUCTION.

Reports received by the United States Geological Survey from 2,800 producers show that 61,824,426 short tons (of 2,000 pounds) of sand and gravel were produced in 1918. However, the production in 1918 was 14,894,899 tons less than in 1917, when it was 76,419,325 tons. Nevertheless, the average price per ton in 1918 was 61 cents, or 33 per cent more than the average, 46 cents, received the year before, so that notwithstanding a heavily decreased output the value of the production in 1918 was $37,927,079, as compared with $35,296,932 in 1917, an increase of $2,630,147.

The producers found business better during the first half of the year, but after July 1, 1918, there was a pronounced decline in the volume of business. The date of this change coincides closely with the date when freight rates were increased. General Order No. 28 of the United States

Railroad Administration, providing for an increase of 25 per cent on practically all commodities, went into effect June 25, 1918. The freight rates on sand and gravel were increased 1 cent for each 100 pounds, or 20 cents a ton, equal to about $6 or $7 a carload. An increase of this kind might not affect products of the higher grades, but it would and did affect those of the lower grades, which sell at the lowest prices.

For a closer insight into the business of 1918 as compared with that of 1917 the opinions of 634 producers of sand and gravel, representing the six States Michigan, Pennsylvania, New York, Illinois, Indiana, and Ohio, are summarized. Of these, 169, or 27 per cent, reported that their trade was better; 153, or 24 per cent, said that trade was about the same; and 312, or 49 per cent, indicated disappointment. Most dealers in glass and foundry sand were in the first category, and a few producers of paving sand were pleased, but nearly all of these were located where highways were under construction or being improved. Most of the 312 disappointed once seemed to be producers of building and paving materials.

To meet the exigencies of war the entire output of some sand and gravel concerns was commandeered by the Government, and the operators accepted their fate with the same splendid spirit that was shown by other business men who also wanted to "do their bit" loyally.

The tables which follow have been prepared by Mrs. L. M. Beach, who also assisted in the preparation of the text.

[Tables omitted.]

* * *

IMPORTS.

There was no record of the quantity of sand imported into the United States between January and June, 1918, although the value is said to have been $44,555; but the imports during the last half of the year amounted to 284,036 short tons, valued at $46,910, an average price of 16½ cents a short ton. The total value of the imports was therefore $91,465 in 1918, as compared with $142,586 in 1917.

The word "imported" is somewhat misleading as regards most of the sand covered by these figures, because some of it was carried as ship's ballast and much of it was building sand brought in from Canada to localities near the border. The importation of some special grades of molding sand, such as the French sand for making fine bronze castings and of refractory sands from England for lining certain iron furnaces, is due to the difficulty of making our foreign-born molders and foundrymen believe that the foreign sands with which they are familiar are no better than the American product.

EXPORTS.

No distinct record of the exports of sand and gravel was kept until 1916. In that year the Bureau of Foreign and Domestic Commerce prepared a table showing such exports, which, however, gave value only, not quantity and kind. The exports of sand have been negligible until recently, but there seems to have been a fair gain in 1918 in spite of the shortage of shipping.

The largest quantity of sand and gravel exported was that sent to Canada for use as building material. No

information is at hand as to the kinds of sand and gravel sent to the other countries named in the following table:

Value of sand and gravel exported from the United States in 1917-1918.

Destination.	1917.	1918.
Canada	$ 415,699	$ 599,876
Mexico	16,892	3,741
Panama	33,941	2,721
Japan	5,951	2,674
England	7,136	2,300
Cuba	1,743	1,788
Newfoundland	1,039	930
Brazil	226	393
China	217	132
Argentina	6	----------
Other countries	11,401	4,859
	494,251	619,414

GLASS SAND.

PRODUCTION.

A total of 2,172,887 short tons of glass sand was produced in the United States in 1918, an increase of 12 per cent over the output in 1917, which was 1,942,675 short tons. The average price in 1918 was $1.94 a ton, an increase of 40 per cent over price in 1917, which was $1.38 a ton. These figures seem especially encouraging to the producers when it is further stated that the total value was $4,209,728 in 1918, as compared with $2,685,014 in 1917, an increase of $1,524,714, or 57 per cent:

Examination of the accompanying table showing the production of glass sand in the six principal producing States in 1917 and 1918 is interesting. In 1917 Illinois,

Pennsylvania, West Virginia, Missouri, New Jersey, and Ohio produced 94 per cent of the entire output of glass sand in the United States, and in 1918 the same States produced 93 per cent. New Jersey had the largest increase in price per ton, 80 cents; Pennsylvania gained 76 cents; West Virginia 73 cents; the inland States – Ohio, Missouri, and Illinois gained 41,39 and 36 cents, respectively. This difference in increased valuation is mainly attributable to freight differentials, for if the freight charges to a given point differ the producer who has the longer haul must lower his price in order to compete with the dealer who has the shorter haul.

The cost of production varies according to the method used. Most of the glass sand produced in Illinois, for example, is obtained by hydraulic mining; most of that produced in Pennsylvania and West Virginia is quarried and crushed. Pennsylvania, West Virginia, and Ohio, in the order named, have the largest number of glass factories,[1] because they have cheap and abundant natural gas for fuel. The producers of glass sand in Illinois and Missouri must sell their product at a low initial price to compete with producers in the other States named.

[1] The glass industry, report on the cost of production of glass in the United States, U.S. Dept. Commerce Misc. Ser. 90, 430 pp., 1917. Sold by the Superintendent of Documents, Government Printing Office, Washington, D. C., price 35 cents.

Glass sand produced in six leading States in 1917-1918.

State.	1917.		
	Quantity (short tons).	Value.	Average price per short ton.
Illinois	607,186	$679,618	$1.12
Pennsylvania	462,972	742,815	1.60
West Virginia	347,640	562,693	1.62
Missouri	153,970	162,838	1.05
New Jersey	100,448	93,194	.93
Ohio	161,408	276,619	1.72

State.	1918.		
	Quantity (short tons).	Value.	Average price per short ton.
Illinois	760,835	$1,273,804	$1.67
Pennsylvania	450,880	1,065,162	2.36
West Virginia	399,936	942,331	2.35
Missouri	141,062	202,763	1.44
New Jersey	139,992	242,762	1.73
Ohio	130,359	277,475	2.13

Glass sand produced in the United States, 1910-1918.

Year.	Quantity (short tons).	Value.	Average price per ton.
1910	1,461,089	$1,516,711	$1.04
1911	1,538,666	1,543,733	1.01
1912	1,465,386	1,430,471	.97
1913	1,791,800	1,895,991	1.06
1914	1,619,649	1,568,030	.97
1915	1,884,044	1,606,640	.85
1916	2,018,317	1,957,797	.97
1917	1,942,675	2,685,014	1.38
1918	2,172,887	4,209,728	1.94

GLASS-SAND LOCALITIES.

The resources of the United States in sand suitable for making the more common kinds of glass are very great. Twenty States produced glass sand in 1918, and it occurs in other States in numerous localities.

Localities where glass sand was reported as produced in 1918.

Arkansas: Ruddells.
California: Ione and Lake Majella.
Georgia: Lumber City.
Illinois: Millington, Oregon, and Ottawa.
Indiana: Michigan City.
Iowa: Clayton.
Kentucky: Olive Hill.
Louisiana: Opelousas.
Maryland: Robinson.
Massachusetts: Cheshire.
Missouri: Crystal City, Klondike, Pacific, and Silica.
New Jersey: Cedarville, Millville, Pembryn, South Vineland, and Williamstown Junction.
New York: Cleveland.
Ohio: Austintown, Howard, Massillon, New Lexington, Silica, and Toboso.
Oklahoma: Hickory and Roff.
Pennsylvania: Daguscahonda, Derry, Dunbar, Falls Creek, Kennerdell, Lewistown, Mapleton, Ridgway, St. Marys, Torpedo, and Vineyard.
Tennessee: Legrange.
Texas: Santa Anna.
Virginia: Mendota.
West Virginia: Berkeley Springs, Buckhannon, Independence, Sturgisson, Terra Alta (Holmes Station), and West Berkeley.

BUILDING SAND.

The output of building sand in 1918 amounted to 19,686,885 short tons, valued at $9,772,556. In 1917 the output was 5,688,102 tons more. In money value the production of 1917 exceeded that of 1918 by $65,132. The decrease in quantity was 22 per cent; the decrease in value was less than 1 per cent.

The Government used a considerable quantity of building sand at numerous army cantonments and also built a large number of more or less temporary offices for its war activities in the city of Washington, as well as large manufacturing plants at other points, in the construction of which large quantities of sand and gravel were used.

In consequence of the restrictions placed upon building for other than Government or war industrial uses, there was a decided decrease in the commercial use of building materials of all kinds. To meet the natural increased demands alone a vast amount of building should have been done in 1918. When normal conditions return the industry will doubtless show great activity.

More building sand was produced in the State of New York in 1918 than any other State, but its total output was very little more than half that of 1917. The output of nearly all the States declined, that of New Jersey alone most closely approaching its output in 1917.

The six leading States in the production of building sand in 1918 were New York, Illinois, New Jersey, Ohio, Pennsylvania, and Indiana, in the order named. These six States produced 50 per cent of the output of the country. There was a general though irregular increase in value,

with Pennsylvania in the lead. Pennsylvania received an average of 33 cents a ton more than in 1917, whereas the price in Ohio advanced only 15 cents and in New York, where the greatest quantity was used, the price advanced only 4 cents.

Building sand produced in six leading States in 1917-18.

State.	1917		
	Quantity (short tons).	Value.	Average price per ton.
New York	3,836,257	$975,512	$0.25
Illinois.....	2,592,774	932,455	.36
New Jersey.....	1,818,275	545,437	.30
Ohio.....	2,318,904	1,090,689	.47
Pennsylvania...	1,996,524	1,319,624	.66
Indiana.....	1,556,922	410,988	.26

State.	1918		
	Quantity (short tons).	Value.	Average price per ton.
New York	1,997,091	$581,835	$0.29
Illinois.....	1,832,195	756,888	.41
New Jersey.....	1,748,576	690,209	.39
Ohio.....	1,722,737	1,062,108	.62
Pennsylvania...	1,537,984	1,529,133	.99
Indiana.....	1,061,189	308,461	.29

MOLDING SAND.

During 1918 the steel mills of the country were busy on war orders and a large number of foundries of metals were working at top speed. For this probably more than for any other reason there was a good demand for molding sand. There was an increase of 5 per cent in the production of sand of this class over that of 1917, and the price

per ton received averaged 13 per cent higher. The output was 4,910,178 short tons, valued at $5,121,865, as compared with 4,660,968 tons, valued at $4,303,809, in 1917.

Molding sand produced in the United States, 1910-1918.

Year.	Quantity (short tons).	Value.	Average price per ton.
1910	3,636,167	$2,431,254	$0.67
1911	3,376,717	2,132,469	.63
1912	4,485,380	2,718,726	.61
1913	3,563,583	2,230,217	.63
1914	2,751,209	1,756,383	.64
1915	3,585,746	2,123,203	.59
1916	4,662,649	3,219,839	.69
1917	4,660,968	4,303,809	.92
1918	4,910,178	5,121,865	1.04

The output of six States which produced 85 per cent of all the domestic molding sand dug in 1918 is given in the following table:

Molding sand produced in six leading States in 1917-18.

State.	1917		
	Quantity (short tons).	Value.	Average price per ton.
Pennsylvania..	640,450	$696,734	$1.09
Illinois	703,208	412,626	.59
Ohio	999,974	1,218,217	1.22
New York	650,427	808,550	1.24
New Jersey	611,916	651,279	1.06
Indiana	287,483	111,732	.39

State.	1918		
	Quantity (short tons).	Value.	Average price per ton.
Pennsylvania..	1,158,715	$953,886	$0.82
Illinois	885,617	658,205	.74
Ohio	857,481	1,493,541	1.74
New York	519,681	770,512	1.48
New Jersey	442,007	626,637	1.42
Indiana	298,934	135,605	.45

FILTER SAND.

Filter sand is clean silica sand in sorted sizes, used for beds in water-filtration plants and in small mechanical filters. A city water supply taken from a stream which may be polluted by organic matter or at times heavily charged with sediment is purified by passing it through a sand filter. As silica is insoluble in water, good filter sand, once installed, may be used a long time. In 1918 the output was 51,111 short tons, valued at $74,977, an average price of $1.47 a ton, as compared with 62,170 short tons, valued at $47,351, or .76 cents a ton, in 1917. This was an increase of 58 per cent in value of output and of 93 per cent in average price per ton.

RAILROAD BALLAST.

There was a considerable decrease in the use of sand and gravel for railroad ballast in 1918, although the value increased, in sympathy with prices in general, from 17 to 22 cents a short ton. This material is produced mainly by the users. The railroads that dig out their own ballast are requested by the Survey to give not only the quantity of their output, but its value, based upon market quotations. Certain producing railroads, however, have reported the

actual cost of the work of production as the value of the ballast, so that the Survey's estimate of value per short ton of output is more likely to be under than over the market value.

OTHER SANDS.

Sands produced for other uses than those already mentioned are inconsiderable in volume yet are of considerable value, and are tabulated as "Other sands."

The man in the street might regard as a joke the statement that sand is used as an ingredient of some fertilizers; nevertheless, in 1918 New York and Pennsylvania reported that 31,110 short tons of sand, valued at $22,360, was used as filler for fertilizer.

Sand is used as bedding for stock cars. Indiana and Iowa sold 6,339 short tons, valued at $1,602, for this purpose. Shippers of livestock may well compare the cost of other forms of bedding with that of sand at the present average cost of only 25 cents a short ton.

A few tons of fine-grained high-grade silica sand is sold annually for use by blacksmiths in welding iron and soft steel. Sand for this purpose is put up in 25-pound sacks and so brings a high price per ton. Likewise, high-grade silica sand, because of its whiteness, is sold in 3 and 5 pound cartons for use in mechanical toys and thus retails at about $60 a ton.

Producers in New York State chronicle the fact that a considerable quantity of sand known as "grits" found ready sale to poultry raisers.

A few hundred tons of clean, even-grained, and high-grade silica sand from Ottawa, Ill., is sold annually in small individual lots for use as a standard in physical tests of other sands. When a testing laboratory determines the strength of a sand as a component of cement, for example, a test of Ottawa sand is made at the same time under similar conditions for comparison. Such a testing sand must be procurable with absolute uniformity of physical characteristics through a long period of years. Ottawa sand meets the requirements and is widely used for this purpose.

CALCULATION OF WEIGHTS, MEASURES, AND VALUES.

The unit used in this report for quantities of sand and gravel is the short ton 2,000 pounds, but many dealers use the cubic yard in their computations and have been so reporting their outputs. Some standard of relation between the two units, however, is necessary, for without such a standard a producer who sells his output by the cubic yard might be getting less for his sand than a competitor who sells by the short ton. Several years ago the Geological Survey asked a large number of producers of sand and gravel to furnish estimates of the average weight of a cubic yard of sand. Some of these dealers made actual tests of the weight of a cubic yard of the sand they sold. The reports show that a cubic yard of sand weighs from 2,000 to 4,000 pounds, the variation being due to differences in mineral composition, moisture content, and packing. The gravels averaged more than the sands, the maximum being 4,200 and the minimum 2,200 pounds. An average of all the weights reported was found, and the result was that a cubic yard of sand is now regarded as

weighing 2,665 pounds and a cubic yard of gravel as weighing 2,820 pounds.

In response to repeated requests from new producers as to the method of converting yards to tons a few examples are here worked out. A producer of molding sand, let us assume, got out 500 cubic yards during the year. To find the number of short tons he produced, he should multiply 500 by 2,665, which will give his output in pounds, and should then divide the product – 1,332,500 – by 2,000 to get the short tons. He would find that he had produced 666¼ short tons.

Possibly this same man sold his sand for $1.35 a cubic yard and is still wondering whether his price equaled that received by his competing neighbor who charged $1.04 a short ton. The competitor received $1.04 for 2,000 pounds of his molding sand. Multiplying 2,665 (the average weight of a cubic yard) by $1.04 and dividing the product by 2,000 gives $1.38½, which is the price the competitor received for an average cubic yard of sand, or 3½ cents more than the man who sold at $1.35 a cubic yard. It happens that $1.04 was the average price per short ton received for molding sand in 1918, and as this is about $1.38½ a cubic yard, some of the readers of this report may discover that they have received more or less than this average through difference in the method they used in selling.

A short method of reducing long tons to short tons is as follows: A long ton contains 2,240 pounds and is therefore 1.12 times as heavy as a short ton. A convenient rule to find the number of short tons is thus to multiply the number of long tons by 1.12.

The quantity of sand in any number of cubic yards may be reduced to weight in short tons by a similar

method. It is, however, necessary that the weight in pounds per cubic yard be known. This, of course, varies in different pits. For sand weighing an average of 2,800 pounds a cubic yard, for example, divide 2,800 by 2,000, which gives 1.4; multiply this quotient by the number of cubic yards, and the product will be the number of short tons. The rule in this case would be: To find the number of short tons divide the weight in pounds of 1 cubic yard by 2,000 and multiply the quotient by the number of cubic yards.

CHATS AND CHERT.

The tables of production given above do not include a considerable quantity of chats or tailings from the Missouri zinc mines. This waste product, which is used on roads, has a nominal value equal to the cost of loading. The shipments of chats in 1918, as reported by the Missouri Bureau of Geology and Mines, amounted to 902,129 short tons, compared with 1,426,716 tons in 1917. Of these shipments in 1917, 1,055,972 tons were from mines in southwestern Missouri and 370,744 tons from mines in southeastern Missouri. More than 1,000,000 tons of this material is believed to have been used for railroad ballast, and the rest for other purposes, such as road metal and concrete.

Neither do the tables include more than 40,000 tons of chert dug in Alabama and valued at more than $17,000.

[Attached to Defendants' Brief in Support of Mineral Ownership and in Opposition to Plaintiffs' Motion for Summary Judgment (Dist. Ct. Docket No. 26)]

DEPARTMENT OF THE INTERIOR
ALBERT B. FALL, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

MINERAL RESOURCES

OF THE

UNITED STATES

1919

G. F. LOUGHLIN
Geologist in Charge, Division of Mineral Resources

PART II – NONMETALS

R. W. STONE, Geologist in Charge

[SEAL]

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

SAND AND GRAVEL

By R. W. STONE.

PRODUCTION.

The sand and gravel produced in the United States in 1919, according to reports received by the United States Geological Survey from producers, amounted to 70,576,407 short tons, an increase of 8,751,981 tons, or 14 per cent, over the production in 1918. The quantity of glass sand, molding sand, and fire sand was less than in 1918, and the quantity of grinding, engine, and filter sand was practically the same in both years; building sand and paving sand, however, were in greater demand in 1919 than in 1918, and, with railroad ballast and gravel, they account for practically all the increase.

The total value of all the sand and gravel produced in 1919 was $45,951,556, as compared with $37,927,079 in 1918.

The following table summarizes the sand and gravel industry for the last five years. It shows at a glance the quantity of material, so far as reported to the United States Geological Survey, that has been transported each year. There is no way to tell how much has been moved by wagon or auto-truck and how much by railroad. It is worthy of note, however, that nearly 1½ million tons annually is used on rails to increase traction. The importance of this sand, listed as engine sand and used both above and below ground on steam and electric railways for hauling passengers and freight is little appreciated. There is no equally cheap substitute, and without this sand many a train would be unable to move.

Sand and gravel produced in the United States, 1915-1919, by kinds, in short tons.

Kind.	1915	1916
Glass sand	1,881,044	2,018,317
Molding sand	3,585,746	4,662,649
Building sand	22,921,426	27,193,462
Grinding and polishing sand	969,718	1,370,354
Fire or furnace sand	529,887	426,654
Engine sand	1,560,201	1,383,034
Paving sand	3,381,717	3,998,548
Filter sand	(a)	76,053
Other sands	1,109,250	1,834,907
Railroad ballast	2,688,766	13,649,827
Gravel	37,972,548	32,477,927
Total	76,603,303	89,091,732

Kind.	1917	1918	1919
Glass sand	1,942,675	2,172,887	1,827,409
Molding sand	4,660,968	4,910,178	3,774,612
Building sand	25,374,987	19,686,885	21,969,736
Grinding and polishing sand	1,179,190	975,265	988,240
Fire or furnace sand	604,035	472,733	355,458
Engine sand	1,410,222	1,462,465	1,481,481
Paving sand	4,348,474	2,722,144	4,431,306
Filter sand	62,170	51,111	58,342
Other sands	1,262,785	666,152	1,083,152
Railroad ballast	10,260,999	8,064,505	8,715,842
Gravel	25,312,820	20,640,101	25,890,829
Total	76,419,325	61,824,426	70,576,407

a Filter sand included "Other sands" prior to 1916.

The demand for sand and gravel was heavier in the latter part of 1919 than in the first half of the year, but car shortage and labor shortage curtailed the output. The opinions of 610 out of an approximate total of 1,200 producers in the five leading States – Illinois, Michigan, New York, Ohio, and Pennsylvania – give some insight into the trend of business. Of these producers 42 per cent reported that their trade was better, 26 per cent said that trade was about the same, and 32 per cent said that they had less business. In New York and Pennsylvania the number of producers who reported trade better and worse was the same, and those in the two States who reported no change were about 20 per cent of those who expressed an opinion. As a matter of fact, the quantity of sand and gravel produced in New York was a little less and the value a little greater in 1919 than in 1918, and in Pennsylvania there was a decrease in both quantity and value.

It must be admitted that the statistics of the sand and gravel industry are incomplete, for there are many small producers whose names are not known to the Geological Survey. This will always be the case, because there are thousands of unrecorded small building operations in the villages and hamlets and on the farms of every State the sand and gravel for which are procured locally and not furnished by a regular dealer. The aggregate quantity of the material so produced must be large. The list of producers maintained by the Geological Survey is always increasing, however, and a small percentage of the output reported each year is always that of producers whose output had not previously been recorded. Therefore as the list of producers increases the statistics each year more nearly represent the actual output of the industry.

The tables in this report have been prepared by Mrs. L. M. Beach, of the United States Geological Survey.

[Tables omitted.]

* * *

IMPORTS.

The quantity of sand imported and entered for consumption in the United States in 1919 was 597,481 short tons, valued at $126,586, or 21 cents a ton. The total value of the imports in 1918 was $91,465 and in 1917 was $142,586. There is no record of the quantity of sand imported into the United States during the first half of 1918, but the imports during the last half of the year amounted to 284,036 short tons, valued at $46,910, an average price of 16½ cents a ton. Some of the sand imported was carried as ship's ballast and was entered at various ocean ports, but most of it was building sand brought in from Canada to localities near the border. For instance, Sandusky, Ohio, gets sand from Pelee Island, which is across the international boundary in Lake Erie.

EXPORTS.

The exports of sand and gravel have been negligible until recently. The largest quantity exported is that sent to Canada for use as building material. No information is at hand as to the kinds of sand sent to the other countries named in the following table. Much of it doubtless is building sand carried as ballast.

Value of sand and gravel exported from the United States in 1917-1919.

Destination.	1917	1918	1919
Canada	$415,699	$599,876	$347,578
Mexico	16,892	3,741	14,803
Panama	33,941	2,721	4,650
Japan	5,951	2,674	3,091
England	7,136	2,300	967
Cuba	1,743	1,788	2,438
Newfoundland	1,039	930	279
Brazil	226	393	40
China	217	132	130
Argentina	6	----------	712
Other countries	11,401	4,859	7,382
	494,251	619,414	382,070

PRICES.

The average price per ton of all sand and gravel reported sold in the United States in 1919 increased from 61 to 65 cents. There was not, however, a general increase in prices, as the average prices of some kinds of sand decreased.

Average prices per short ton of sand and gravel marketed in the United States, 1915-1919.

Kind.	1915	1916
Glass sand	$0.85	$0.97
Molding sand	.59	.69
Building sand	.30	.32
Grinding and polishing sand	.46	.65
Fire, or furnace, sand	.34	.90
Engine sand	.32	.37
Paving sand	.32	.36

Filter sand	(a)	.90
Railroad ballast	.13	.13
Gravel	.25	.32
All kinds	.30	.33

Kind.	1917	1918	1919
Glass sand	$1.38	$1.94	$1.97
Molding sand	.92	1.04	1.10
Building sand	.39	.50	.56
Grinding and polishing sand	1.04	1.60	1.34
Fire, or furnace, sand	1.15	1.48	1.23
Engine sand	.59	.76	.77
Paving sand	.41	.54	.66
Filter sand	.76	1.47	1.48
Railroad ballast	.17	.22	.30
Gravel	.46	.57	.66
All kinds	.46	.61	.65

a Figures not available.

The prices given in this table for each use were obtained by dividing the total value of the sand sold by the total number of tons sold. High-grade glass sand in certain localities brought $2.50 to $3 in 1919, but large quantities of low-grade silica sand used for making colored glass bottles and other cheap glass were dug from sand dunes by steam shovel and sold for less than 50 cents a ton; thus the average price was brought down to less than $2 a ton. Although building sand sold in some of the large eastern cities in 1919 around $1 to $2 a ton, this was exceptional, and sand for building purposes throughout most of the country, except in large cities, was sold for about 50 cents a ton.

The average price of most of the different sands listed in the table has either doubled or a little more than

doubled in the last five years. The average price of grinding and polishing sand has nearly trebled, and that of fire or furnace sand has much more than trebled.

GLASS SAND.

PRODUCTION.

A total of 1,827,409 short tons of glass sand was produced in the United States in 1919, a decrease of 16 per cent from the output in 1918. The average price in 1919 was $1.97 a ton, an increase of 3 cents over that of 1918. The total value of all glass sand produced in 1919 was $3,593,371, a loss of nearly 15 per cent as compared with 1918. The accompanying table, showing the production of glass sand in the six principal producing States in 1918 and 1919, brings out the fact that the quantity produced was less in 1919 in each of the States except West Virginia, which made a gain. West Virginia was the only one of the six States, however, in which the average price per ton was less in 1919. Pennsylvania, New Jersey, and Missouri made nominal gains in average price per ton; Illinois increased 22 cents and Ohio 28 cents.

The quantity of glass sand reported as produced in Indiana was about 8,000 tons more than the production in Ohio. The Indiana material, however, was mostly of low-grade (dune sand) and was produced and sold at small cost, and the figures can not well be used in comparison with those of the six leading States in the production of high-grade glass sand.

Glass sand produced in six of the leading States in 1918 and 1919.

State.	1918		
	Quantity (short tons).	Value.	Average price per ton.
Illinois	760,835	$1,273,804	$1.67
Missouri	141,062	202,763	1.44
New Jersey	139,992	242,762	1.73
Ohio	130,359	277,475	2.13
Pennsylvania	450,880	1,065,162	2.36
West Virginia	399,936	942,331	2.35

State.	1919		
	Quantity (short tons).	Value.	Average price per ton.
Illinois	521,286	$886,707	$1.70
Missouri	135,683	209,938	1.55
New Jersey	121,799	225,036	1.85
Ohio	79,580	191,565	2.41
Pennsylvania	325,810	797,068	2.45
West Virginia	407,918	933,863	2.29

Glass sand produced in the United States, 1910-1919.

Year.	Quantity (short tons).	Value.	Average price per ton.
1910	1,461,089	$1,516,711	$1.04
1911	1,538,666	1,543,733	1.01
1912	1,465,386	1,430,471	.97
1913	1,791,800	1,895,991	1.06
1914	1,619,649	1,568,030	.97
1915	1,884,044	1,606,640	.85
1916	2,018,317	1,957,797	.97

1917	1,942,675	2,685,014	1.38
1918	2,172,887	4,209,728	1.94
1919	1,827,409	3,593,371	1.97

GLASS-SAND LOCALITIES.

The resources of the United States in sand suitable for making the more common kinds of glass are very great. Nineteen States produced glass sand in 1919, and it occurs in other States in numerous localities.

Localities where glass sand was reported as produced in 1919.

Arkansas: Guion.
California: Ione and Lake Majella.
Georgia: Lumber City.
Illinois: Millington, Oregon, Ottawa, Utica, and Wedron.
Indiana: Michigan City.
Kentucky: Lawton.
Louisiana: Le Blanc.
Maryland: Robinson.
Massachusetts: Cheshire.
Michigan: Rockwood
Missouri: Crystal City, Festus, Gray Summit, Klondike, and Pacific.
New Jersey: Cedarville, Millville, Pembryn, South River, South Vineland, and Williamstown Junction.
Ohio: Austintown, Barberton, Chalfants, Howard, Massillon, and Toboso.
Oklahoma: Hickory and Roff.
Pennsylvania: Derry, Dunbar, Falls Creek, Kennerdell, Lewistown, Mapleton, Newton Hamilton, Parrish, Ridgway, St. Marys, and Torpedo.
Tennessee: Legrange.
Texas: Santa Anna.

West Virginia: Berkeley Springs, Great Cacapon, Greer, Imperial, Sturgisson, Terra Alta (Holmes Station), Thayer, and West Berkeley.
Wisconsin: Ripon.

BUILDING SAND.

The output of building sand in 1919, so far as reported to the Geological Survey, amounted to 21,969,736 short tons, valued at $12,296,664, an increase of more than 2,000,000 tons and $2,500,000 over the output of 1918. The six leading States in the production of building sand in 1919 were Illinois, Ohio, New York, New Jersey, Pennsylvania, and Indiana, in the order named. In total value of output, however, Pennsylvania led, the average price per ton in that State being 85 cents, which was much higher than that in any of the other leading States. The table shows an increase in average price per ton in each State except Ohio and Pennsylvania.

Building sand produced in the six leading States in 1918 and 1919.

State.	1918		
	Quantity (short tons).	Value.	Average price per ton.
Illinois	1,832,195	$756,888	$0.41
Indiana	1,061,189	308,461	.29
New Jersey	1,748,576	690,209	.39
New York	1,997,091	581,835	.29
Ohio	1,722,737	1,062,108	.62
Pennsylvania	1,537,984	1,529,133	.99

State.	1919		
	Quantity (short tons).	Value.	Average price per ton.
Illinois	2,187,682	$1,027,452	$0.47
Indiana	1,093,836	434,085	.40
New Jersey	1,640,704	763,896	.47
New York	1,974,827	705,603	.36
Ohio	2,063,918	1,173,324	.57
Pennsylvania	1,517,957	1,289,827	.85

MOLDING SAND.

The quantity of molding sand produced in 1919 was about 1,100,000 tons less than in 1918, and the total value was nearly $1,000,000 less. The average price per ton, however, was higher than ever before, being $1.10. Some molding sand sold for well over $2 a ton, and the average price in Ohio was $1.65, but large quantities of sand were sold in Illinois and Indiana for very much less than $1 a ton. In fact, in Indiana particularly hundreds of thousands of tons of dune sand for steel molding were sold for much less than 50 cents a ton.

The very considerable reduction in quantity of molding sand produced in 1919 can doubtless be ascribed in part to the strike of the steel workers.

Molding sand produced in the six leading States in 1918 and 1919.

State.	1918		
	Quantity (short tons).	Value.	Average price per ton.
Illinois	885,617	$658,205	$0.74
Indiana	298,934	135,605	.45

New Jersey.....	442,007	626,637	1.42
New York.....	519,681	770,512	1.48
Ohio.....	867,481	1,493,541	1.74
Pennsylvania.....	1,158,715	953,886	.82

State.	1919		
	Quantity (short tons).	Value.	Average price per ton.
Illinois.....	482,219	$338,893	$0.70
Indiana.....	572,292	243,199	.42
New Jersey.....	501,583	583,656	1.16
New York.....	418,319	609,730	1.46
Ohio.....	689,555	1,137,356	1.65
Pennsylvania.....	512,862	712,460	1.39

Molding sand produced in the United States, 1910-1919.

Year.	Quantity (short tons).	Value.	Average price per ton.
1910.....	3,636,167	$2,431,254	$0.67
1911.....	3,376,717	2,132,469	.63
1912.....	4,485,380	2,718,726	.61
1913.....	3,563,583	2,230,217	.63
1914.....	2,751,209	1,756,383	.64
1915.....	3,585,746	2,123,203	.59
1916.....	4,662,649	3,219,839	.69
1917.....	4,660,968	4,303,809	.92
1918.....	4,910,178	5,121,865	1.04
1919.....	3,774,612	4,153,990	1.10

OTHER SANDS.

Sands sold for uses not specifically designated in the foregoing tables amounted in 1919 to 1,083,152 short tons, valued at $439,194. Most of this quantity – 509,107 tons,

valued at $128,445, or 25 cents a ton – was dune sand, dug along the shore of Lake Michigan in northern Indiana and used for filling, probably to fill swampy land or to grade around the great manufacturing plants along the lake shore.

Under this heading is included also sand sold for fertilizer filler, for bedding in stock cars, for use in mechanical toys, for use by blacksmiths in welding iron and soft steel, for testing sand for laboratory determinations, and for miscellaneous purposes. One producer reported a few tons sold as "propagating sand," by which is probably meant sand for use in greenhouses to start seedlings.

ASSOCIATIONS OF SAND AND GRAVEL PRODUCERS.

The organization of the sand and gravel producers in various parts of the country is progressing rapidly as the benefits of such action are recognized. The association of men engaged in any industry helps the advancement of that industry. Cooperation works for the common good. Mutual benefits are derived from getting together and understanding the other man's problems. Individuals can do little to protect their business from discriminatory regulations, but a solid association of producers united on a proposition can get results.

The National Association of Sand and Gravel Producers was organized in 1911 for the purpose of obtaining mutual benefits, including equitable rates from the railroads. An appreciation of the benefits procured by such organizations has resulted in the formation of several State and regional or local associations. The associations known to the Geological Survey are as follows:

American Sand Association (composed of producers of Silica and molding sand in eastern Ohio and western Pennsylvania), Pittsburgh, Pa.
Arkansas Valley Association of Mineral Aggregate Producers, Tulsa, Okla.
Chicago Sand & Gravel Producers' Association, 1406 City Hall Square Building, Chicago, Ill.
Georgia Sand & Gravel Producers' Association, Atlanta, Ga.
Great Lakes Sand & Gravel Producers' Association, Sandusky, Ohio.
Illinois Association of Sand & Gravel Producers, Lincoln, Ill.
Indiana Sand & Gravel Producers' Association, 122 East Ohio Street, Indianapolis, Ind.
Iowa Sand & Gravel Producers' Association, Des Moines, Iowa.
Missouri Valley Association of Mineral Aggregate Producers, 706 American Bank Building, Kansas City, Mo.
National Association of Sand & Gravel Producers, 702 City Trust Building, Indianapolis, Ind.
Nebraska Aggregates' Association, Omaha, Nebr.
Pennsylvania Sand & Gravel Producers' Association, 1101 Diamond Bank Building, Pittsburgh, Pa.
Silica Sand Association of Illinois, Central Life Building, Ottawa, Ill.
Wisconsin Mineral Aggregate Association, 382 First National Bank Building, Milwaukee, Wis.

TECHNICAL JOURNALS.

The technical journals that give considerable space to the sand and gravel industry are:

Cement, Mill, and Quarry, 542 Monadnock Block, Chicago, Ill.

Pit and Quarry, Rand-McNally Building, Chicago, Ill.
Rock Products, 542 South Dearborn Street, Chicago, Ill.

UNITED STATES DISTRICT COURT

District of Nevada

BEDROC LIMITED, L.L.C., a Nevada limited Liability Company, and EARL WILLIAMS, an individual,

Plaintiff/ Counterdefendants,

v.

THE UNITED STATES OF AMERICA; BRUCE BABBIT, Secretary of the Interior; UNITED STATES DEPT. OF THE INTERIOR; BUREAU OF LAND MANAGEMENT; and CURTIS L. TUCKER, Area Manager, Caliente Resource Area, Bureau of Land Management,

Defendants/ Counterclaimants.

JUDGMENT IN A CIVIL CASE

CV-S-98-01012-PMP (LRL)

___ Jury Verdict. This action came before the Court for a trial by jury. The issues have been tried and this jury has rendered it's verdict.

_X_ Decision by Court. This action came to be considered by

the Court. The issues have been considered and a decision has been rendered.

IT IS ORDERED AND ADJUDGED

Plaintiffs' Motion for Summary Judgment is DENIED. IT IS FURTHER ORDERED that Defendants' Brief in Support of Mineral Ownership and Opposition to Plaintiffs' Motion for Summary Judgment, requesting a judicial declaration finding the United States to be the owner of all valuable minerals underlying Bedroc's real property, including the sand and gravel deposits, is GRANTED.

JUDGMENT IS HEREBY ENTERED in favor of Defendants and against Plaintiffs.

May 25, 1999 — Date

LANCE S. WILSON — Clerk

Entered and Served May 25, 1999

/s/ — By Deputy Clerk